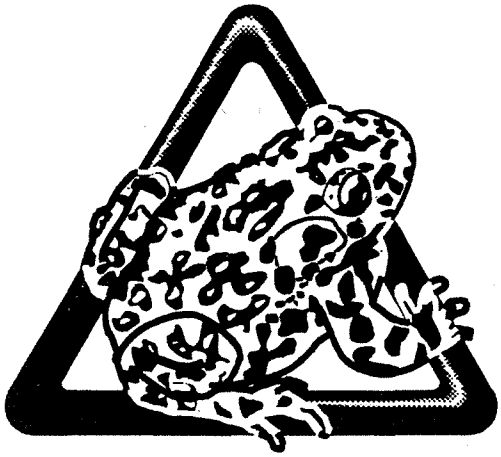

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Report V. 1.0

Sierra Nevada Anuran Survey: An Investigation of Amphibian Population Abundance In The National Forests of The Sierra Nevada of California

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Contributing Scientists: William E. Bros, SJSU; Dana L. Dondero, Canorus Ltd.; Mark R. Jennings, CAS; and Hartwell H. Welsh, USFS

Prepared for U.S. Forest Service

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Summer 1992 Survey

Prepared for U.S. Forest Service in Fulfillment of Two Cost Share Agreements, one with Eldorado National Forest and the other jointly with Sierra, Sequoia and Stanislaus National Forests

Abstract

Surveys to document the presence or absence of anuran populations in the Sierra Nevada of California were conducted in Eldorado, Sierra, Sequoia, and Stanislaus National Forests from June 1, 1992 to August 28, 1992. The Sierra Nevada Anuran Survey Protocol was used to standardized the method of data collection and provide a survey technique which can be repeated over time. Surveys of native anurans including the foothill yellow-legged frog, mountain yellow-legged frog, Yosemite toad, western toad, Pacific treefrog and California red-legged frog revealed extremely patchy distributions and small populations. The foothill-yellow legged frog, mountain yellow-legged frog and Yosemite toad were found in only a few localities in small populations, indicating that these species should be considered endangered at this time. Populations of the more common western toad and Pacific treefrog also revealed reduced population sizes. The California red-legged frog was not located at any of the sites surveyed and should be considered critically endangered. These trends suggest a large scale cause for the decline of these animals. Utilizing standardized techniques for surveying, this survey, over successive years, could reveal clues as to the decline of these animals and render a plan of action to help ensure their future survival.

Acknowledgments

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Disclaimer

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Introduction

Background

Dramatic declines in a number of amphibian species throughout the world have been reported in recent years (Bury and Luckenbach, 1976; Bury et al., 1980; Hammerson, 1982; Hayes and Jennings, 1986). Many of these declines can be explained by local habitat destruction (e.g., deforestation, industrial pollution and land development) (Wake, 1990, 1991; Wake and Morowitz, 1990; Baringa, 1990), but population declines in seemingly pristine environments, such as those in National Forests, are largely unexplained at this time (Corn and Fogleman, 1984; Sherman and Morton, 1984; Stolzenburg, 1989; Corn et al., 1989; Bradford, 1989; Hart and Hoffman, 1989; Wake, 1990, 1991; Wake and Morowitz, 1990; Baringa, 1990; Martin, 1990, 1991 a&b; Bradford et al., 1993).

Amphibians are sensitive bio-indicators of environmental health due to their physiology, complex (or biphasic) life history, ecosystem interactions, and population biology. Amphibians have gills in the larval stage, and as adults, they have specialized skin which has evolved into a respiratory organ. These two structures, along with amphibian eggs, are extremely permeable to gases and liquids and are thus extremely susceptible to toxins in the air, water and terrestrial substrate. Many amphibians estivate or hibernate in soils and mud, which potentially exposes them to toxic conditions at a time when they may not be able to respond (Wake and Morowitz, 1990).

Most amphibians have a biphasic life history whereby the aquatic larval forms, which consume detritus, algae and plant materials, develop into terrestrial adult forms that consume insects and other invertebrates. Thus, these animals are exposed not only to the aquatic and terrestrial environment but also to different trophic levels of the food chain. Many amphibians have developed a life strategy where long-lived animals with high fecundity reproduce in a variable environment. This type of life strategy can allow amphibians to quickly respond to favorable environmental conditions and dramatically increase their population size. However, these animals can just as quickly succumb to adverse environmental conditions and plummet into extinction after several successive years of detrimental environmental conditions.

One result of this rapidly responding life strategy is intense intra- and inter-specific competition for resources (especially in the larval stage), that would rapidly reflect any differences in tolerance to pollutants through changes in species composition. All of these factors combine to make amphibians more sensitive to varying environmental conditions, such as acid precipitation and habitat destruction, than any other group of vertebrates. As a result of this, amphibians can serve as highly tractable models of environmental fitness, which can be tested in manipulative studies in the laboratory and in semi-field and field conditions to determine the cause-effect relationships between animals and their environment. (Wake and Morowitz, 1990; Dunson et. al., 1992).

There are six native anuran species which occur in the central portion of the Sierra Nevada of California. These include the California toad (Bufo boreas halophilus), California red-legged frog (Rana aurora draytonii), foothill yellow-legged frog (Rana boylii), mountain yellow-legged frog (Rana muscosa), Yosemite toad (Bufo canorus) and Pacific treefrog (Pseudacris (=Hyla) regilla). Four of these six anurans have shown declines which have resulted in their being listed by the US. Fish and Wildlife Service as a category two species (candidate for listings as a threatened or endangered species status) and as a species of special concern by the California Department of Fish and Game. A breakdown of each individual species' status is as follows:

The California red-legged frog has been recommended for endangered status and appears to have disappeared from over 99% of its former range in the Central Valley and Sierra foothills (Jennings and Hayes, In review, 1985, 1986, 1988).

The foothill yellow-legged frog has been recommended for threatened species status in the west slope drainages of the Sierra Nevada. Localities where this species is extant in the northern Sierra Nevada appear widely scattered, and populations of these frogs are absent from much of the southern Sierra Nevada range (Jennings and Hayes. In review (pers. observation).

The mountain yellow-legged frog has been recommended for threatened status in the Sierra Nevada. The extent of the decline is still unknown, but local population declines and extinctions have been observed at a number of localities throughout its range (J. Boundy, D. Bradford, L. Cory, R. Hansen and M. Morton, pers. comm.; pers. observ., Jennings and Hayes, In review). Introductions of exotic fishes in the Sierra have been implicated in the decline of this species (Bradford, 1989, 1991, 1992; Bradford et. al., In press a&b).

Finally, the Yosemite toad, which has been recommended for endangered status, appears to be absent from 50% of its historical range. Most of the remaining populations of this animal exist only in very low densities (Hayes and Jennings, In review; Martin 1990, 1991 a&b, In prep.; Sherman and Morton, 1984).

Additionally, the California toad and the Pacific treefrog appear to be declining in parts of the higher elevation areas as well as many lowland areas of the Sierra Nevada (Martin, Jennings and McCready, pers. observation). A seventh non-native anuran, the bullfrog, is also found in certain low altitude areas of the Sierra Nevada, and it is implicated in the decline of some native species (Bury and Luckenbach, 1976; Hammerson, 1982; Hayes and Jennings, 1986).

Populations of the anurans in the Sierra have been surveyed intensively at a limited number of localities in order to gather information on breeding biology, population structure, and general ecology (Byrant, 1917; Zweifel, 1955; Mullally and Cunningham, 1956 a&b; Karlstrom, 1962; Briggs and Storm, 1970; Briggs 1976, 1987; Sherman, 1980; Bradford, 1983, 1984; Jennings, 1984; Green, 1986 a&b; Blaustein and O'Hara, 1987; Hayes and Jennings, 1988; Clarkson and Rorabaugh, 1989). Some historical locality surveys have recently been conducted (Bradford, 1993.; Jennings and Hayes, in review; Martin, in prep.), but due to the variation of techniques in these surveys, the information collected is not comparable between investigators, or over time, and the exact duplication of historical surveys by

subsequent investigators is virtually impossible. For this reason a protocol was established to standardize the method of surveying for anurans in the Sierra Nevada. This provides consistency in method of randomized site selection, survey techniques, and data collection and processing, so that surveys are repeatable and comparable in the future by the same or different investigators. Furthermore, and of even greater importance, this protocol surveys all anurans in the Sierra Nevada rather than individual species, therefore providing an accurate assessment of the status of these anurans not only as individual species, but in relation to each other as well.

Objectives

This project proposes to document the presence or absence of anuran populations in the Sierra Nevada of California, as well as document the relative abundance of anurans surveyed at each site. The information gathered can be compared with other survey sites and examined to determine the overall status of anurans within each of the habitat types, townships, forests, and elevational zones surveyed. The most important objective of this project is to ensure that the survey technique used for this study is standardized. This standardization will allow the survey to be repeated in subsequent years to track population fluctuations over time. Additionally, this standardization will allow the comparison of survey sites from the present study with sites selected at a later date to render new insights into the distribution and ecology of anuran species in the Sierra Nevada of California.

History of Project

In early 1991, four of the six species of anurans occurring on lands managed by the National Forest Service in the Sierra Nevada of California were listed as category two species under the Endangered Species Act. One of these species was soon elevated to category one or candidate status for listing as endangered with the other three species soon to follow. This alarming trend, along with the realization that the Forest Service had little to no information available on the distribution or current densities of these animals, prompted the use of non-game species survey moneys to surveying anuran populations within three National Forests (Sierra, Sequoia, and Stanislaus) in the Sierra. A group of Forest Service fisheries biologists (Matthew Lechner, Marilyn Myers, and Bob Ruediger led by Mary Kay Buck) attempted to determine the most useful and efficient way to survey for amphibian populations in the Sierra Nevada. They soon discovered that little information was available on surveying for amphibians, so they enlisted the assistance of amphibian ecologists to assist with the planning of the Sierra Nevada Anuran Survey.

D.L. Martin - Sierra Nevada Survey

Early in 1992 the survey project began with the drafting of a protocol for surveying anuran populations in the Sierra Nevada (Anuran Survey Protocol for the Sierra Nevada of California, Martin, et. al.; 1992). The ultimate goal of this protocol was to survey for amphibian populations in such a way that the data would be comparable between sites, between forests, over time, and eventually between successive investigators. Once the protocol was written it was determined that David Martin would lead the survey effort for the Forest Service. In order to hire the necessary field personnel and decrease the overhead costs (which would have deeply cut into the project resources), a company was formed (Canorus Ltd.) to conduct the anuran surveys for the Forest Service under a cost share agreement.

George Elliott, fisheries biologist for Eldorado National Forest, learned of the survey effort underway and acquired funding for additional anuran surveys in this Forest which dramatically broadened the scope of this project.

This document reports the results of the first year of utilizing the anuran survey protocol for tracking fluctuations in anuran populations and establishing current population densities.

Materials and Methods

Survey Site Selection

The surveys took place within Sierra, Sequoia, Stanislaus and Eldorado National Forests in the central and southern portion of the Sierra Nevada of California (Fig. 1). Survey sites within each forest were randomly selected using official Forest Service maps which are broken down into townships. Each township, comprised of at least 50% National Forest, was identified as being either low or high elevation. Low elevation townships are designated as all those townships with the average elevation between 60m and 2100m above sea level. High elevation townships have an average elevation between 2100m and 3400m above sea level. Once the townships were designated as high or low elevation, they were divided and numerically identified. Four townships from the high elevation pool and four townships from the low elevation pool were randomly selected (townships selected are listed in Table 1). Low and high elevation townships were surveyed in two separate groups. The low elevation townships were surveyed first, followed by the high elevation townships. This division was an attempt to increase the chances of finding active anuran populations, but reduced the chances of finding breeding congregations during snow melt at higher elevations. This division could render misleading data configurations showing abnormally high anuran densities.

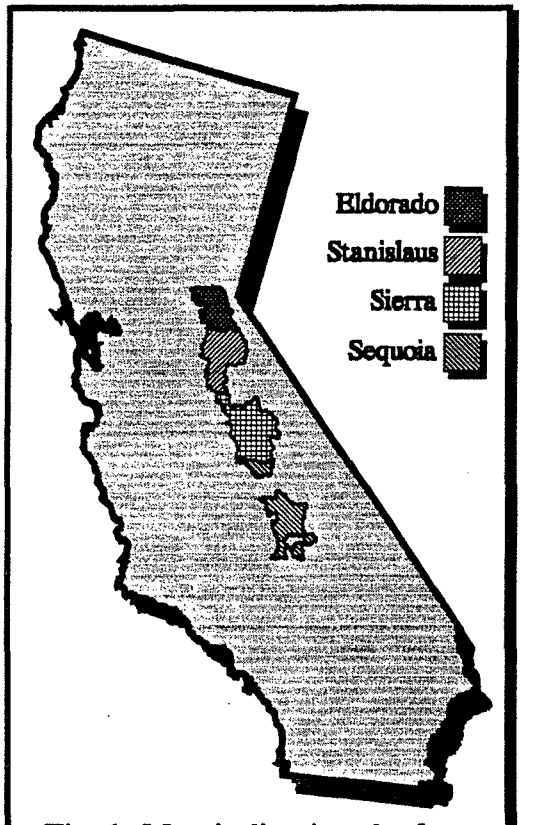

Fig. 1. Map indicating the four forests surveyed.

Within each township, the major crossings, such as roads or trails, of streams or rivers were identified. These crossings, or survey site origins, were compared with historical locality data (museum records, literature records, sightings by knowledgeable biologists) and the habitat (as discernible from topographic maps) to determine the eight crossings most likely to reveal populations of anurans. These crossings or site origins were then ranked from one to eight, with the most likely site for amphibian habitat being first and the least likely being eighth. The first and second ranked site origins within each township were surveyed (Table 1), with the remaining six site origins held in reserve in case one of the first two site origins was deemed unacceptable for some reason upon field survey (e.g. on going logging activity or

fenced private property). Each of the two site origins selected were surveyed over a two day period. The first day the stream/river was surveyed downstream from the site origin, and the second day survey progressed upstream from site origin. Forest Service map overlays indicating the townships, ranges, sections and actual sites surveyed are contained within appendix A.

Townships Selected in 1992

Forest	Township	Range	Section
Eldorado	T9N	R13E	14
Eldorado	T9N	R13E	13
Eldorado	T10N	R14E	29
Eldorado	T10N	R14E	34
Eldorado	T10N	R15E	1
Eldorado	T10N	R15E	1
Eldorado	T10N	R15E	30
Eldorado	T10N	R16E	16
Eldorado	T10N	R16E	29
Eldorado	T10N	R17E	16
Eldorado	T10N	R17E	29
Eldorado	T11N	R17E	19
Eldorado	T11N	R17E	22
Eldorado	T9N	R17E	4
Eldorado	T9N	R17E	16
Eldorado	T9N	R18E	12
Eldorado	T9N	R18E	26
Stanislaus	T1S	R18E	28
Stanislaus	T1S	R18E	29
Stanislaus	T1S	R19E	33
Stanislaus	T1S	R19E	31
Stanislaus	T2S	R19E	7
Stanislaus	T2S	R19E	7
Stanislaus	T2S	R19E	30
Stanislaus	T7N	R16E	26
Stanislaus	T7N	R16E	35
Stanislaus	T6N	R20E	5
Stanislaus	T6N	R20E	6
Stanislaus	T8N	R19E	15
Stanislaus	T8N	R19E	29
Stanislaus	T5N	R21E	18
Stanislaus	T5N	R21E	17
Stanislaus	T3N	R20E	6
Stanislaus	T3N	R20E	3

Forest	Township	Range	Section
Sierra	T9S	R24E	32
Sierra	T9S	R24E	11
Sierra	T10S	R25E	2
Sierra	T10S	R25E	27
Sierra	T10S	R26E	17
Sierra	T10S	R26E	17
Sierra	T10S	R26E	12
Sierra	T6S	R22E	2
Sierra	T6S	R22E	8
Sierra	T8S	R30E	20
Sierra	T8S	R30E	17(SW)
Sierra	T9S	R29E	20(SE)
Sierra	T9S	R29E	18(SE)
Sierra	T8S	R27E	7
Sierra	T8S	R27E	-
Sierra	T8S	R26E	3
Sierra	T8S	R26E	18
Sequoia	T20S	R30E	9
Sequoia	T20S	R30E	26
Sequoia	T23S	R31E	3
Sequoia	T23S	R31E	34
Sequoia	T26S	R31E	36
Sequoia	T26S	R31E	36
Sequoia	T26S	R31E	24
Sequoia	T19S	R32E	21
Sequoia	T19S	R32E	32
Sequoia	T25S	R32E	18
Sequoia	T25S	R32E	27
Sequoia	T24S	R34E	20
Sequoia	T24S	R34E	22
Sequoia	T23S	R34E	32
Sequoia	T23S	R34E	34
Sequoia	T22S	R34E	17
Sequoia	T22S	R34E	5

Table 1. Listing of the forests, townships, ranges and sections which were randomly selected for survey.

Survey Crews

Survey crews consisted of two field biologists in each of the four National Forests. All crews attended a one week training period, which took place during the week of May 25, 1992, under the supervision of the project coordinator. This training included familiarization with and identification of anurans present in the areas to be surveyed. Crew members were provided with the "Sierra Nevada Anuran Guide" (Martin, 1993), hereafter known as the SNAG, which was used as reference during the surveys to control for errors in identification. As a secondary precaution against misidentification, the crews were given instructions and training for photographing anurans encountered in the field. Additionally, they were trained to collect and preserve a limited number of voucher specimens. Also included during this week of training were mock surveys to familiarize crew members with the proper techniques for using field equipment and filling out field survey data sheets (see protocol; Martin, et.al., 1993). The survey crews also gained experience walking Sierra streams, tributaries, meadows and lakes searching for anurans as a team. The field surveys began on June 1, 1992 and were concluded by August 28, 1992.

Survey Procedures

Each crew began the survey by placing an 18" plastic survey stake (wooden stakes were used in wilderness areas) above the high water mark at the north west junction of the road/trail crossing of the stream/river. This stake was then marked using a fine point permanent black marker (sharpie) with the date, survey crew members initials and the survey site locality. The hip-chain line was then anchored to the survey stake and reset to zero, the beginning time was recorded on the data sheet, and the survey began. The initial survey from each site origin (the first day of the two days of surveying to be conducted from each survey site origin) commenced downstream from the site origin stake. On the second day the crew would survey upstream from the site origin stake. Surveys took place between the hours of 09:00 and 18:00 in order to provide standardized time boundaries for all crews. However, in a few cases survey times did extend beyond the 18:00 hour stopping time by several minutes, but the time never exceeded 19:00.

Streams and Tributaries

Each survey crew consisted of two crew members who walked in the stream on opposite sides utilizing D-shaped aquatic nets to flush anurans from cover, capture anurans attempting to escape, and sweep for amphibian larvae in the vegetative growth along the margins of the stream. When the survey crew intersected a tributary (a tributary is defined as a stream smaller than the main channel but greater than 0.25 meters across), the crew recorded the time and distance at the point of intersection on the survey data sheet and tied the hip-chain line to a wire stake flag and anchored it at the intersection point between the main channel and the tributary. The crew then

surveyed 50 meters of the tributary in the same manner as the main stream survey. Other smaller tributaries were ignored. At the end of the 50 meter tributary survey, the time and distance (50 meters) were recorded, the hip-chain line cut, and the crew returned as fast as possible to the intersection with the tributary and main stream channel without searching for anurans. Upon reaching the intersection, the hip-chain line was tied to the wire stake flag, the time and distance were recorded, and the survey continued as before on the main stream channel.

Meadows

When the survey crew intersected a meadow, the beginning distance or meters traveled and time upon reaching the intersection was recorded on the survey data sheet. The crew members then continued to survey the stream channel while taking a linear measurement of the stream with the hip-chain until the end of the meadow was reached. At that time the hip-chain line was cut and tied to a wire stake flag, and the distance traveled through the meadow and the time upon reaching the intersection was recorded. The crews then surveyed the meadow area concentrating on vernal pools, the margins of willows, and the stream bank. Once the meadow survey was completed, the two crew members returned to the meadow stream intersection, attached the hip-chain line to the wire stake flag, recorded the time of meadow survey completion, and continued the survey of the stream.

Lakes

When the survey crew intersected a large pond or lake (pools or small ponds were treated as wide streams), the crew member with the hip-chain continued to survey the littoral zone on the shortest side within the lake while the other crew member surveyed the littoral zone from the bank or shore. The crew member on the bank was responsible for surveying any meadow areas associated with the lake. Once again, meadow surveys concentrated on vernal pools, the margins of willows, and the lake shore. Any tributaries feeding into the lake were ignored. The main stream inlet or outlet were the only intersections recorded. If the hip-chain crew member reached the intersection of the lake before the other crew member, the hip-chain line was cut and tied to a wire stake flag placed at the intersection. The hip-chain crew member then assisted the other crew member with the meadow survey. When the meadow survey was completed, the two crew members returned to the wire stake flag, attached the hip-chain line to the flag, recorded the time and distanced traveled, and continued the stream survey.

Survey Conclusion

After approximately five hours of survey time, the time at completion and the distance traveled were recorded on the survey data sheet. The survey crew then returned to the survey starting point by way of the stream to retrieve as much of the hip-chain line as possible, and all wire stake flags. The survey crew then marked their survey path on the Forest Service map as well as on the topographic map(s) of the

area. The field survey data sheets were then double checked for accuracy and duplicated. The original field survey data sheet was given to the project coordinator as soon as possible for data entry.

Anuran Identification

During the survey process, anurans at any given stage of development were captured. The species scientific name, stage of development (e.g., eggs, larvae, juveniles, adults), and habitat in which the animal was found were recorded on field survey data sheets. Anurans captured were identified, using the SNAG whenever necessary, especially in the case of larval or egg mass identification, and both team members agreed on the identification. As a secondary precaution against misidentification in the field, the dorsal, lateral and ventral surfaces of the specimens were then photographed on a photo-board (see protocol; Martin et. al., 1993) with the appropriate information filled in on the photo-board data-log. Egg masses were photographed in the water with the photo-board data-log in close proximity. The purpose of the photo-boards was to document the presence of amphibians without unnecessarily reducing anuran populations by collection and preservation of voucher specimens. A small number of voucher specimens were retained (see below) to scientifically and legally document anuran presence, but all other anurans were released unharmed at the point of collection.

Voucher Specimens

A small number of voucher specimens were taken to document the identification and distribution of anuran populations encountered during the survey. These specimens were used to confirm the species identification made by field crews and corroborate the field data collected. Additionally, these specimens served as a permanent scientific and legal record of species distribution in the Sierra Nevada.

The first adult anuran of each species found in each of the survey sites was collected, euthanized in a 15% solution of ethanol alcohol, tagged with the collectors' names, date, locality, site, township, and preserved in 10% buffered formaldehyde solution. The specimens were either injected with the preservation solution or the visceral cavity was opened by incision to allow the penetration of preservation fluid. A maximum of two adult specimens per species were taken from each township.

Four larval anurans from each species found were collected at each survey site, two from the upstream survey and two from the downstream survey, with a maximum of eight larval specimens per species taken from each township. The larvae were euthanized in a 15% solution of ethanol alcohol and then transferred into jars containing a 10% buffered formaldehyde solution which penetrates into the visceral cavity without injection or incision. A specimen tag with the collectors' names, date, locality, survey site and township was placed in the jar with the specimen.

One egg mass was collected from each species encountered at each survey site origin, for a maximum of 2 egg masses taken per species per township. After photographing the eggs with the photo-board data log placed next to the egg mass in the water, the mass was removed and placed directly into a jar containing a 10% buffered formaldehyde solution with a label listing the collectors' names, date, locality, survey site, time and township.

All voucher specimens, along with the photo-board pictures and survey data sheets, are deposited in the collections of the California Academy of Sciences, Golden Gate Park, San Francisco, CA, 94118.

Experimental Design and Analysis

To examine the relative density and distribution of anuran species in the forests surveyed, the data gathered by the survey crews are nested into hierarchical levels. This stratification method organizes the data set into geographic categories which are easily distinguishable from one level to another and helps to describe the levels of variation encountered within the data set and between geographic regions.

The smallest category or level was habitat type which was classified as stream, tributary, meadow or lake. The crews recorded the number of individuals of each anuran species collected within habitat patches encountered during each site survey. Additionally, the amount of time spent surveying each habitat patch was recorded as well as the length or distance of each patch.

The second level of data gathered was the daily site surveys. The site survey information consists of a summation of the habitat type data. The total amount of time (approximately five hours) and distance surveyed each day was recorded along with the total number of individual anuran species encountered during the survey. Each site survey was classified as upstream or downstream, depending on the direction the survey progressed from the survey site origin.

The site origin, township, forest and elevational categories were produced as an artifact of the site selection process. The appropriate daily site survey data were combined within the data base to produce a data summary for each of the geographic categories. The data can then be used to describe the density and distribution of anurans within and between each geographic region. Species densities were calculated and graphed using Excel 4.0 (Microsoft, 1992). Species diversity indices (Shannon-Weiner, Simpson's, Hill's 1 and Hill's 2) and evenness (Pielou's J) for each of the four forests surveyed were computed, using algorithms presented in Ludwig and Reynolds (1988) to compare distributions of individuals among species. Calculations and comparisons were performed using SYSTAT (Wilkinson, 1990).

Results

The data collected within each of the four National Forests surveyed are summarized in Table 2. Six of the seven species of anurans occurring in the Sierra were encountered during the survey. Additionally, a population consisting of California toad X Yosemite toad hybrid individuals was encountered. A complete data set for all sites surveyed and the resultant data are presented for each forest in appendix B-E.

1992 Forest Data Summary

Forest	Meters Stream Surveyed	Meters Tributary Surveyed	Meters Meadow Surveyed	Meters Lake Surveyed	Total Meters Surveyed	Minutes Stream Surveyed	Minutes Tributary Surveyed	Minutes Meadow Surveyed	Minutes Lake Surveyed	Total Minutes Surveyed
Eldorado	34,406	421	1,554	1,252	37,634	7,486	102	800	366	8,754
Stanislaus	39,216	794	1,796	802	42,608	8,320	164	784	514	9,782
Sierra	17,672	978	6,289	1,606	26,544	4,935	294	3,356	221	8,806
Sequoia	47,445	6,445	12,693	241	66,824	7,174	699	1,666	101	9,640
Total	**138,739**	**8,638**	**22,332**	**3,901**	**173,610**	**27,915**	**1,259**	**6,606**	**1,202**	**36,982**

Forest	Pacific treefrog				Calif. red-legged frog			
	Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
Eldorado	0	1020	4	1024	0	0	0	0
Stanislaus	0	305	4	309	0	0	0	0
Sierra	7	433	344	784	0	0	0	0
Sequoia	1	12223	222	12446	0	0	0	0
Total	**8**	**13981**	**574**	**14563**	**0**	**0**	**0**	**0**

Forest	Foothill yellow-legged frog				Bullfrog			
	Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
Eldorado	0	150	4	154	0	0	0	0
Stanislaus	0	0	0	0	0	189	37	226
Sierra	0	0	0	0	0	0	0	0
Sequoia	0	0	0	0	0	0	0	0
Total	**0**	**150**	**4**	**154**	**0**	**189**	**37**	**226**

Forest	Mountain yellow-legged frog				California toad			
	Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
Eldorado	0	0	0	0	0	0	0	0
Stanislaus	0	223	4	227	0	11	0	11
Sierra	0	0	2	2	0	0	0	0
Sequoia	0	0	0	0	0	203	667	870
Total	**0**	**223**	**6**	**229**	**0**	**214**	**667**	**881**

Forest	Calif. toad X Yosemite toad				Yosemite toad			
	Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
Eldorado	0	1000	41	1041	0	0	0	0
Stanislaus	0	0	0	0	0	0	0	0
Sierra	0	0	0	0	0	2	57	59
Sequoia	0	0	0	0	0	0	0	0
Total	**0**	**1000**	**41**	**1041**	**0**	**2**	**57**	**59**

Table 2. Summary of data collected for each of the four forests (complete data is available in Appendix B-E).

Survey Effort

A total of 36,982 m of habitat types was surveyed between each of the four forests (Table 3). The mean distance surveyed for each forest was 1378 m but the standard deviation was 692 m, indicating large variation in the data set (Fig. 2). This variation was likely caused by the different proportions of habitat types surveyed within each forest. For example, Sequoia National Forest, which had the greatest total distance of habitats surveyed, also had the greatest distance of stream surveyed. Whereas Sierra National Forest had the least amount of total habitats surveyed and the shortest distance of stream surveyed.

Meters Surveyed in Each Forest

Habitat	Eldorado	Stanislaus	Sierra	Sequoia	Totals
Stream	34,406	39,216	17,672	47,445	**138,739**
Tributary	421	794	978	6,445	**8,638**
Meadow	1,554	1,796	6,289	12,693	**22,332**
Lake	1,252	802	1,606	241	**3,901**
Totals	**37,633**	**42,608**	**26,545**	**66,824**	**173,610**

173,610 Total Meters Surveyed

Table 3. Comparison of the meters surveyed in each habitat type and in the four forests.

The total amount of time spent surveying the four forests was 36,982 minutes (Table 4). The mean number of minutes surveyed for each forest was 293 with a standard deviation of 31 minutes. The variation in the amount of time surveyed in each forest is also probably caused by the different proportions of habitat types surveyed within each forest. But the amount of variation within each forest is significantly less than that contained within the distance data set (Fig. 2).

Minutes Surveyed in Each Forest

	Eldorado	Stanislaus	Sierra	Sequoia	Totals
Stream	7,486	8,320	4,935	7,174	**27,915**
Tributary	102	164	294	699	**1,259**
Meadow	800	784	3,356	1,666	**6,606**
Lake	366	514	221	101	**1,202**
Totals	**8,754**	**9,782**	**8,806**	**9,640**	**36,982**

36,982 Total Minutes Surveyed

Table 4. Comparison of the time spent in each habitat type and in the four forests.

It would appear that a greater amount of survey effort is needed to survey meadow habitats which would explain some of the difference between time and distance measurements. For example, Sequoia National Forest had the greatest number of meters surveyed, but it had the second highest amount of time surveyed. This difference in effort measures may be due to the higher percentage of meadow surveyed in this forest. The only distance measurement taken is the meadow stream channel, but the majority of the time spent surveying the meadow is spent walking the meadow itself, which is not measured. For this reason, the length of time spent surveying a site is a better indicator of survey effort than the distance surveyed.

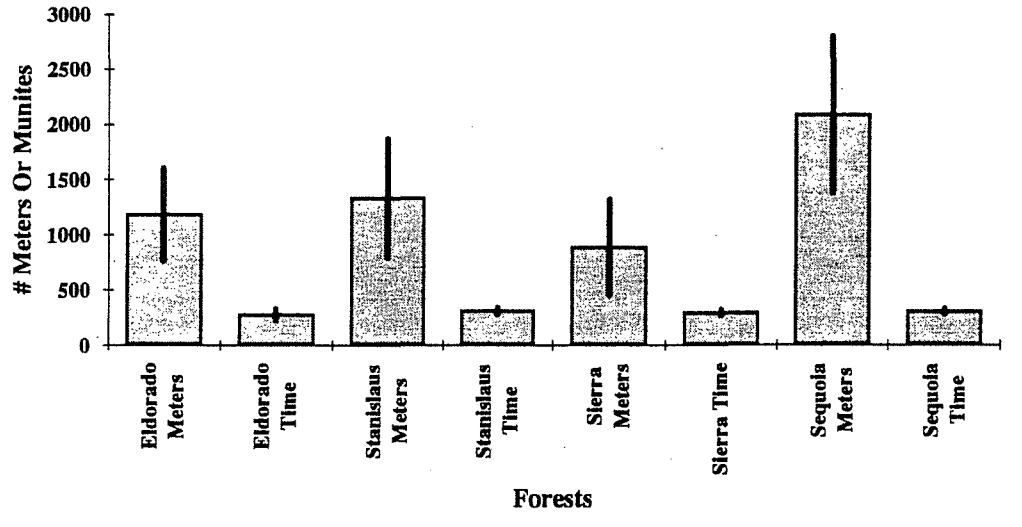

Fig. 2. Comparison of the mean distance and time surveyed for each forest. Bars show means ± 1 SE.

Figure 3 shows the difference in the amount of variation between the time and distance surveyed within each forest. The X axis segregates out the four forests surveyed, and it shows no variation. The Y axis or minutes axis shows some vertical variation, but the majority of the data points are clumped vertically. The Z axis shows a large amount of scatter in almost a linear fashion, doe to the large amount of variation found only in this axis. The crews were instructed to survey for approximately a five hour period, so one should expect the variation in the amount of time spent surveying forests to be less than the variation in the distance measured. There is, however, some variation in the amount of time surveyed, so the number of individuals collected at each site cannot be directly compared without calculating the catch per unit effort or relative density of anurans within each site.

The relative density of anurans within each site was defined as the total number of individuals captured per unit effort. The survey effort can be determined by the length of time surveying a given site or habitat type. As was previously stated the length of time surveyed seems to be a more uniform index of survey effort than the distance surveyed, so the catch per unit effort is equal to the number of anurans

collected divided by the number of minutes spent surveying a given site. For example, the relative density of an anuran species in a given township can be determined by the total number of individuals of that species encountered within that township divided by the total amount of time spent surveying that same township.

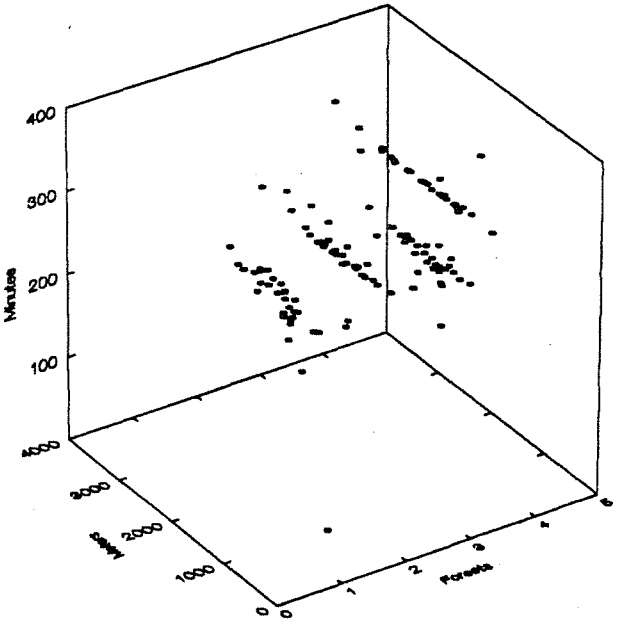

Fig. 3. Three dimensional plot of survey effort (minutes vs. meters surveyed) between forests.

Species Distribution

A total of 17,153 anurans were surveyed in all four forests with the largest number of individuals found in Sequoia National Forest (Table 5). One species, Pacific treefrog accounted for 84% of the total number of individuals encountered. The majority of these individuals were surveyed within a single meadow site in Sequoia. The anuran species encountered in the other three forests were found in small populations, except the California toad X Yosemite toad hybrids. These toads were found in large numbers at two sites in Eldorado. It should be noted that the Red-legged frog was not encountered during this survey.

Number of Individuals in Each Forest

	Eldorado	Stanislaus	Sierra	Sequoia	Total
Pacific treefrog	1,024	309	784	12,446	**14,563**
Bullfrog	0	226	0	0	**226**
Calif. red-leg	0	0	0	0	**0**
Foothill yellow-leg	154	0	0	0	**154**
Mt. yellow-leg	0	227	2	0	**229**
Calif. toad	0	11	0	870	**881**
Calif. X Yosemite	1,041	0	0	0	**1,041**
Yosemite toad	0	0	59	0	**59**
Total	**2,219**	**773**	**845**	**13,316**	17,153

17,153 Total Anurans Surveyed

Table 5. Comparison of each species within and between forests.

The largest age class surveyed in the majority of species encountered during the survey was the larval stage (Fig. 4). This result was expected due to the high fecundity of anurans and the relatively conspicuous nature of tadpoles in the aquatic environment. The only egg masses collected during the summer belonged to the relatively late breeding Pacific treefrog. It would appear that the timing of surveys to avoid breeding congregations was successful.

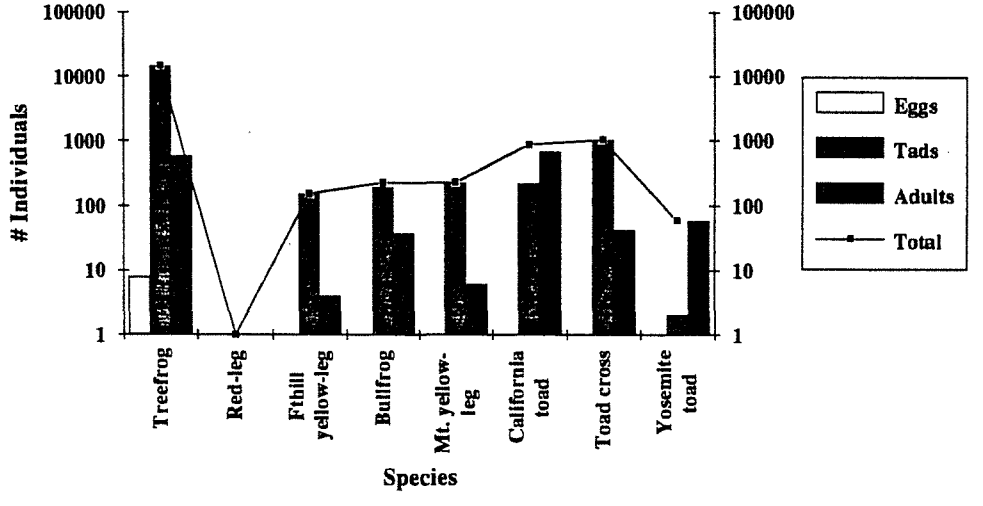

Fig. 4. Comparison for each species of the age classes and the number of individuals surveyed on a Log scale.

The distribution of anuran species between high and low elevation sites was not statistically significant due to the slightly different habitat preferences of all species except the treefrog which is found throughout the Sierra at all elevations (Fig. 5). The California toad like the treefrog can be found at high or low elevations, but this species is displaced by the Yosemite toad which is endemic to most of the high elevation areas of Stanislaus and Sierra. The California toad was, however, found at one high elevation site in Stanislaus. and in five high elevation sites within Sequoia, but it was not found at low elevations (Fig. 6). The mountain yellow-legged frog and Yosemite toad were found exclusively in high elevation sites, and the bullfrog and foothill yellow-legged frog were found exclusively in low elevation townships, as would be expected by the available natural history information (Stebbins, 1985).

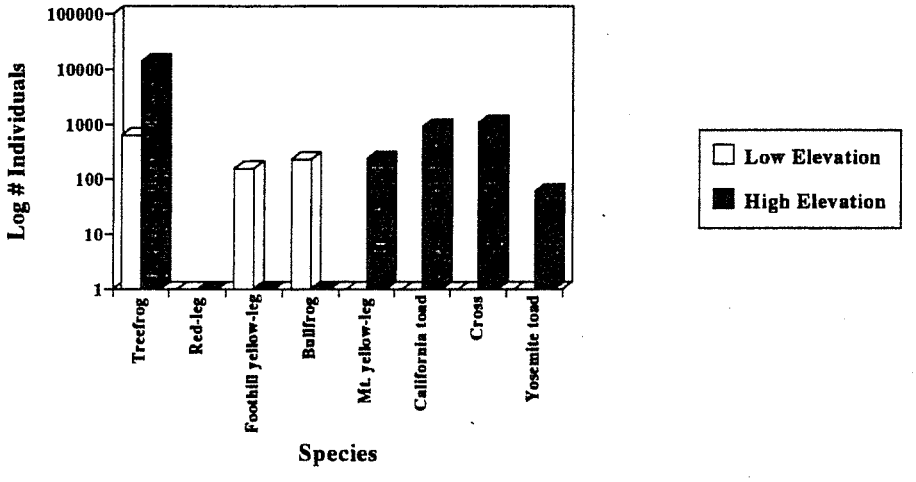

Fig. 5. Distribution of species collected within high or low elevation.

The distribution of anurans between forests shows that species such as the Yosemite toad, mountain yellow-legged frog, and foothill yellow-legged frog were only be found in one forest (Fig. 6), whereas their historical distributions would suggest a much wider distribution (Jennings and Hayes, in review). Additionally, the introduced bullfrog was found only in one forest, whereas historically was found throughout much of the low elevation areas in the Sierra. The distribution of species within forests was also small (Fig. 6). Historically, all of the anuran species listed should be found in all of the forests surveyed, with the exception of Yosemite toad which should only be found in two of the forests (Stebbins, 1985; Jennings and Hayes, in review). The only anuran species found in all of the forests surveyed was the Pacific treefrog, but even its distribution was uneven between forests. And finally, it should

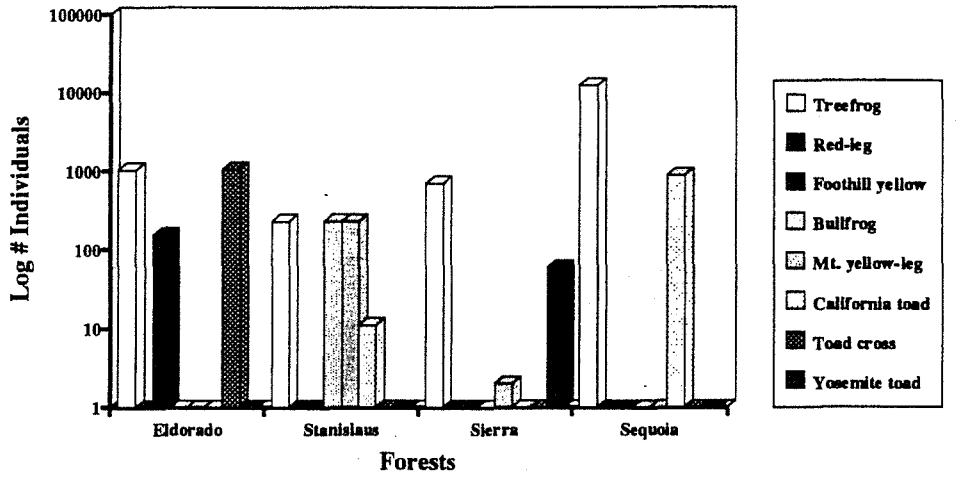

Fig. 6. Distribution of species collected within forests.

be noted again that the California red-legged frog was not encountered during this survey.

The relative abundance of anuran species between forests shows that at least 95% of the relative distribution of each species is in one forest (Fig. 7). Only the Pacific treefrog has more than 3% of its relative distribution in a second forest, and it was the only species to be found in more than two forests. The distribution of individuals between townships shows a similar pattern, suggesting that the current distribution of anuran species in the Sierra Nevada is extremely patchy (Fig. 8).

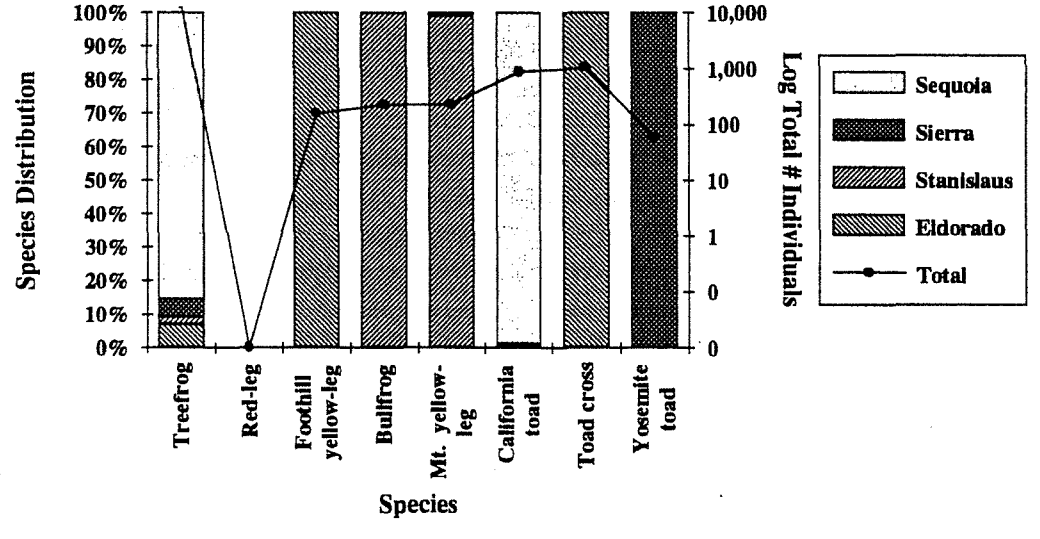

Fig. 7. Comparison of the relative distribution (percent of total) of anuran species between forests with the total number of individuals of each species collected (overlay).

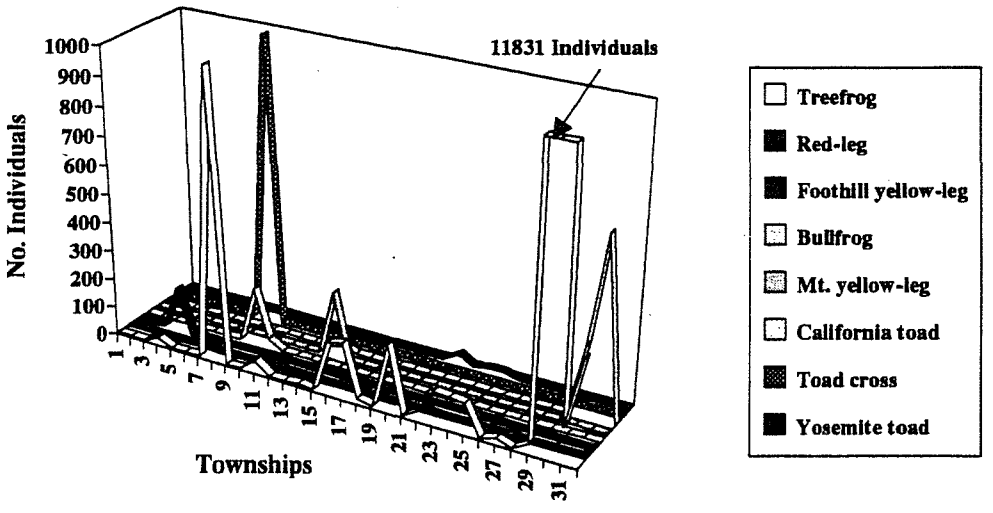

Fig. 8. Distribution of species between townships.

Species Diversity

The Shannon-Weiner, Simpson's, HMax, Hill's 1 and Hill's 2 species diversities indices were calculated for each of the four forests surveyed and are compared in figure 9. The Shannon-Weiner index is the lowest of the five indices because it is the most affected by a small number of species being analyzed. The Simpson's or dominance index is slightly higher because this index is not affected by very rare species as much as the Shannon-Weiner index. The Hill's indices tend to normalize the data and are less affected by rare species because they tend to measure the degree to which proportional abundance's are distributed among the species (Ludwig and Reynolds, 1988). Regardless of which species index is used, the species diversity of all four forests are low. Stanislaus has the highest diversity, primarily because the largest number of species (4) were found in this forest (Table 2, Fig.6); but Stanislaus also had the lowest number of individuals encountered during the surveys (Table 5). Eldorado has the next highest indices, because it contained high numbers of three species. Sierra and Sequoia had similar indices even though Sierra contained three species and Sequoia contained only two, because Sequoia had 12,446 individuals from one species whereas Sierra had 845 individuals from a number of species.

A comparison of the species richness, or number of species encountered within each forest (S= # species), with the evenness (Pielou's J) of species distribution within that forest, can be used to help classify each forest according to the diversity of anuran species (Fig. 10). Sequoia, for example, has the lowest richness, but predominately consisted of just one species the Pacific treefrog. Eldorado and Sierra had about equal richness, but Eldorado was much more evenly distributed. Stanislaus showed relatively high richness and evenness due to the higher number of species encountered

during the survey, even though the total number of individuals found was fewer than in the other forests.

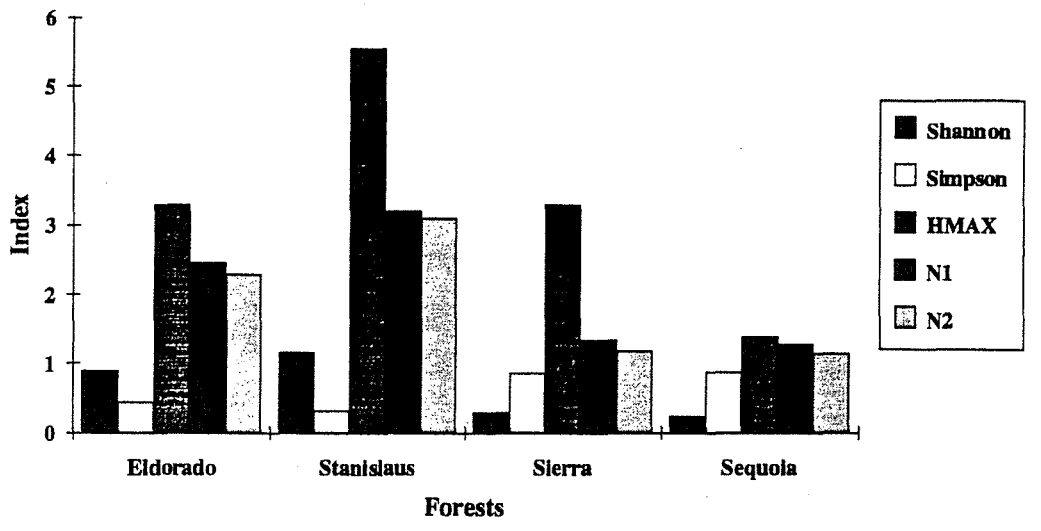

Fig. 9. Comparison species diversity indices by forests.

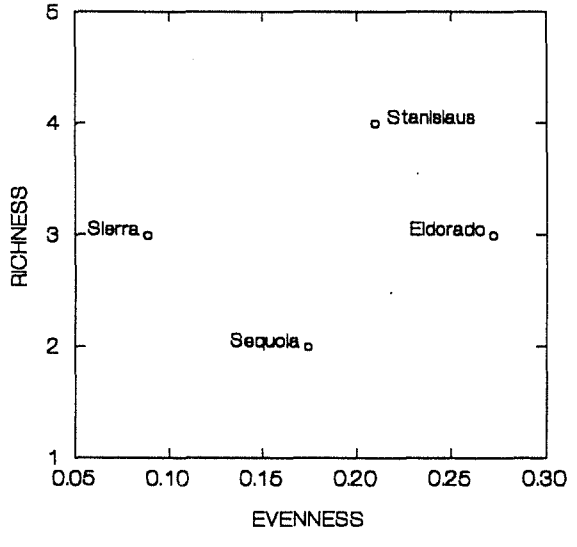

Fig. 10. Comparison of species richness (S= No. species) vs. evenness (Pielou's J) for each forest.

Species Habitat Preferences

The stream habitat type had the greatest number of patches among the forests surveyed (N=85)(Fig. 11). The majority of these habitat types were distributed in Sierra. (N=32). Tributaries had the second largest number of habitat patches (N=71), with greater than half of those patches being distributed in Sequoia (N=39). The habitat type with next largest the number of patches was meadow (N=55), with the majority of these patches occurring in Sierra (N=31). Finally, the habitat with the least number of patches was the lake habitat type (N=6).

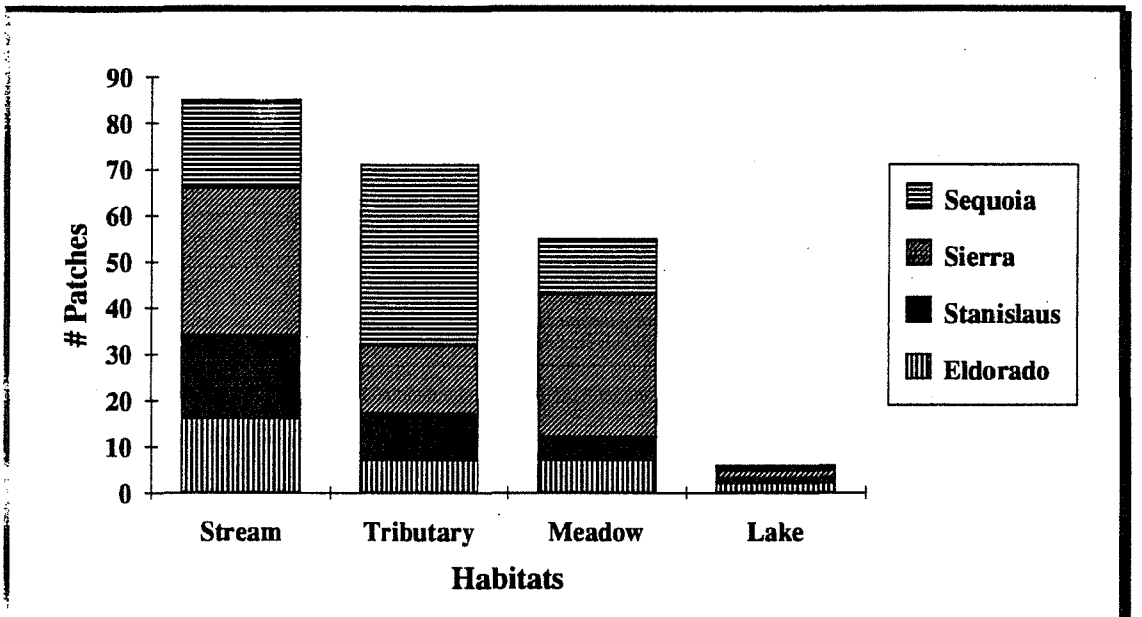

Fig. 11. Distribution of the number of major habitat patches within each forest.

All four forests had representatives of each of the four habitat types. The stream habitat type had the most equal distribution of total individuals surveyed between each the forests surveyed (Fig. 12). The other three habitat types contained species in only three of the four forests, and the distribution of species between those forests was unequal.

Streams were also the only habitat type to contain individuals of all anuran species encountered during the surveys (Fig. 13). The foothill yellow-legged frog, bullfrog, and mountain yellow-legged frog, for example, were all found exclusively in stream habitats. The California toad, Yosemite toad, and California toad X Yosemite toad were found predominantly in the meadow habitat type, but they were still encountered during stream habitat surveys. A small number of hybrid individuals were also found in the tributary habitat. The Pacific treefrog was the only species found in

all four habitat types and the red-legged frog was not found in any of the habitat types surveyed.

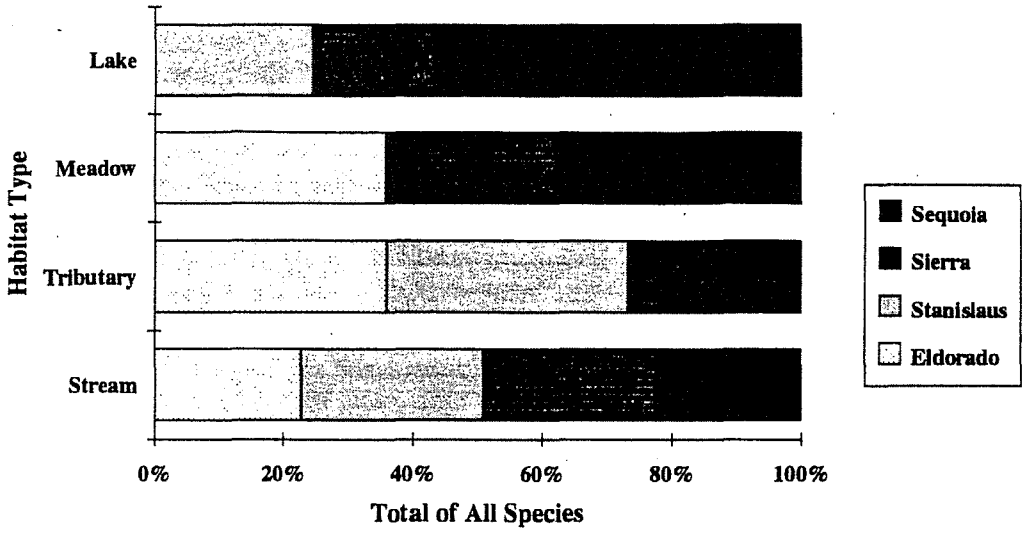

Fig. 12. Distribution of the number of individuals of each species surveyed within each of the four major habitat types.

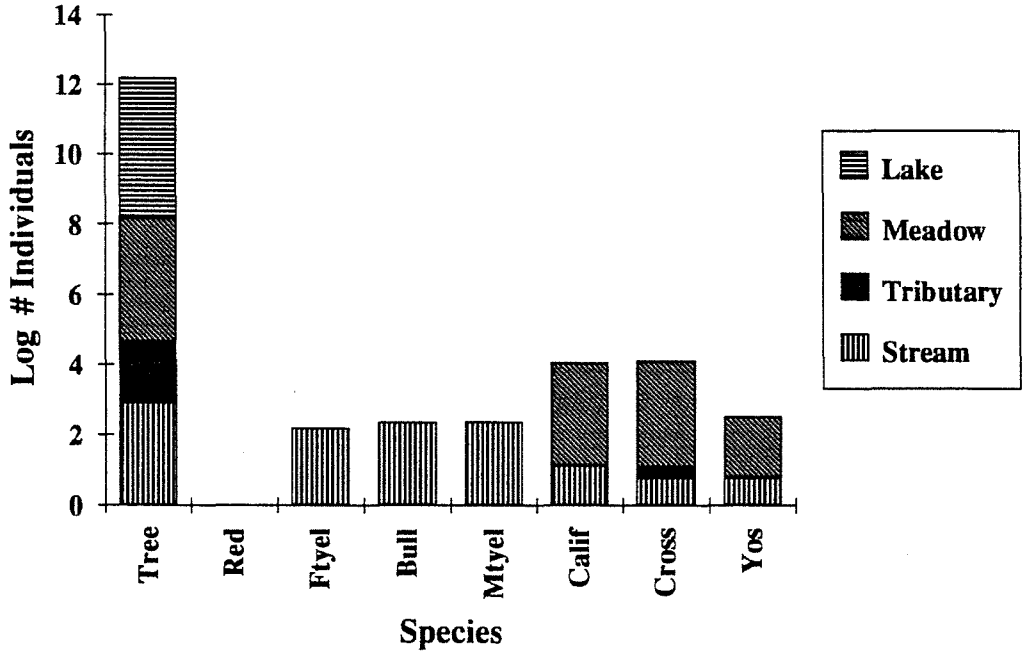

Fig. 13. Distribution of the number of individuals collected from each forest within the four major habitat types.

Discussion, Conclusions and Recommendations

Results from the field surveys show that all species of anurans which historically occurred in the Sierra, with the exception of the California red-legged frog, are still present. The Pacific treefrog was found during this survey in several localities in small, but evenly distributed populations. The status of this animal is good, but it should be noted that the overall population level should be considered low.

The foothill yellow-legged frog was found in two survey locations. In one of these sites, only a single individual was located. At the other site a number of tadpoles and several adults were found, indicating a population which is reproducing in small numbers. The status of this animal should be considered endangered in the Sierra Nevada. Only two populations of this animal have been sighted south of Eldorado National Forect in the past two years. The sightings were in Stanislaus in the Clavey River drainage (Brode, Rudiger; pers. comm.) and in Sierra in the Jose Creek drainage (Holland, pers. comm.). These two populations must be intensively re surveyed to determine if populations of these animals still occur at these two sites. If so, immediate measures must be taken to protect these populations.

The bullfrog, introduced into the region, is of little value in the Sierra and should be considered an injurious pest. This animal has been implicated in the decline of native Ranids and, for this reason alone, should be eliminated where ever possible. This survey found the distribution of this animal to be highly sporadic, most likely due to the extensive drought in California. But populations of these animals are extremely dense in some areas and could eliminate native frog species.

The mountain yellow-legged frog was located in four sites during the surveys. Three of the sites are represented by a single specimen, indicating extremely small populations. A fourth population in Stanislaus National Foresr revealed over 200 individuals of all age classes, indicating a reproducing population. Sporadic populations of these animals do occur throughout the Sierra (Jennings, Bradford, Buck; per. comm.; Martin, per. observ.). But these populations should be considered the exception. Fish introductions and disease have been implicated in the decline of this animal, and recolonization has been all but stopped due to introduced fishes in the Sierra (Bradford, 1989, 1991; Bradford et. al., In Press a&b; Jennings and Hayes, In Review). Overall, this species should be considered endangered. At locations where populations of these animals remain, fish stocking in the entire drainage must be stopped, and if self reproducing populations of trout or char occur, active efforts to reduce or eliminate these introduced fishes should be made. (Rotenone is not an acceptable method because it kills frogs at all stages of development as well as fish.)

The Yosemite toad was found in one site in Stanislaus National Forest and in several sites throughout the high elevation areas of Sequoia, but only in very small numbers. Overall, this animal has declined from over 50% of its range, and remaining

populations are extremely small (Sherman and Morton, 1984; Martin 1990, 1991 a&b, 1992 In Prep; Jennings and Hayes, In Review). Cattle grazing, introduced fishes, acid precipitation, and disease have all been implicated in the decline of this species (Jennings and Hayes, In Review; Bradford et. al., 1991; Martin, 1990, 1991 a&b, 1992 In Prep; Sherman and Morton, 1984). The overall status of this animal should be considered endangered. Management strategies, such as the elimination of fish stocking and cattle grazing from areas where breeding populations occur, should be considered of paramount importance.

The California red-legged frog was not encountered during this survey, and independent surveys of all historical localities within the National Forests surveyed failed to produce a single individual. A few isolated populations of this species do still occur in the Northern Sierra, but it appears to be extinct in much of the Central and Southern Sierra (Jennings and Hayes, In Review; Martin, pers. observ.). This animal must be considered critically endangered. All extant populations should be identified and protected from any disturbances, including grazing and exotic species introductions.

Overall Status of Anurans

Distribution of anurans in the Sierra Nevada appears to be extremely patchy and sporadic, suggesting that harsh environmental conditions are forcing these animals into small refugia of acceptable habitat. At this time there does not seem to be a difference in anuran populations at low vs. high elevations, but there does seem to be a north to south trend in the Sierra. This trend suggests that a greater number of Ranid species, occurring in larger populations, are in the Northern Sierra than in the Southern Sierra. The species diversity indices further back up this contention.

Habitat Preferences

Anuran species in the Sierra seem to prefer stream and meadow habitats over lake and tributary habitats. This trend is probable due to a combination of introduced fishes in the larger lakes forcing these animals into smaller bodies of water. Also, the past 6 years of drought has forced these animals out of tributaries and small pools late in the season. Stream surveys produced the largest number of individuals and the most even sampling of species.

The long term trends in amphibian populations are still unknown at this time. In order to document trends, surveys using consistent survey techniques over long periods of time are of paramount importance. This report summarized the short-term trends found in amphibian populations using a consistent survey technique, but the real power of this survey is the information on anuran populations trends over the next 5-10 years as the survey is repeated. Only by repeating this survey over successive years can the trends in population fluctuations be evaluated to determine patterns which will render clues as to the causes of the anuran decline. Hopefully, these clues will be the

determinate for a plan of action that will reverse the decline of these species and insure their future.

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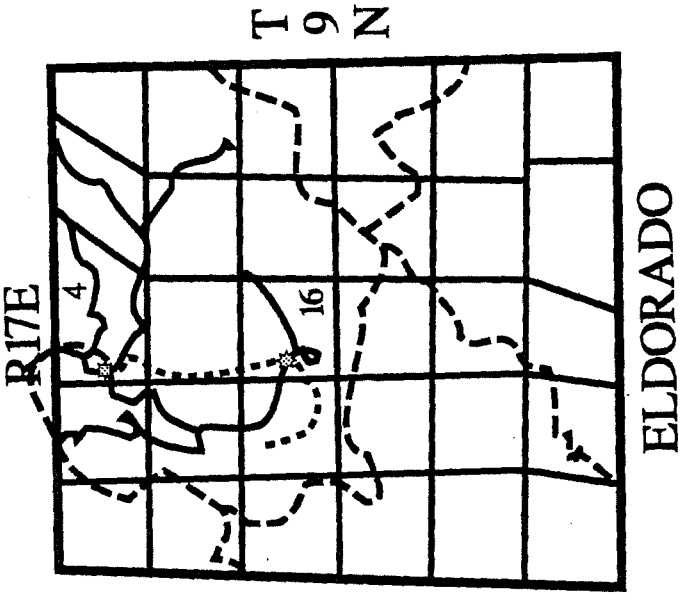
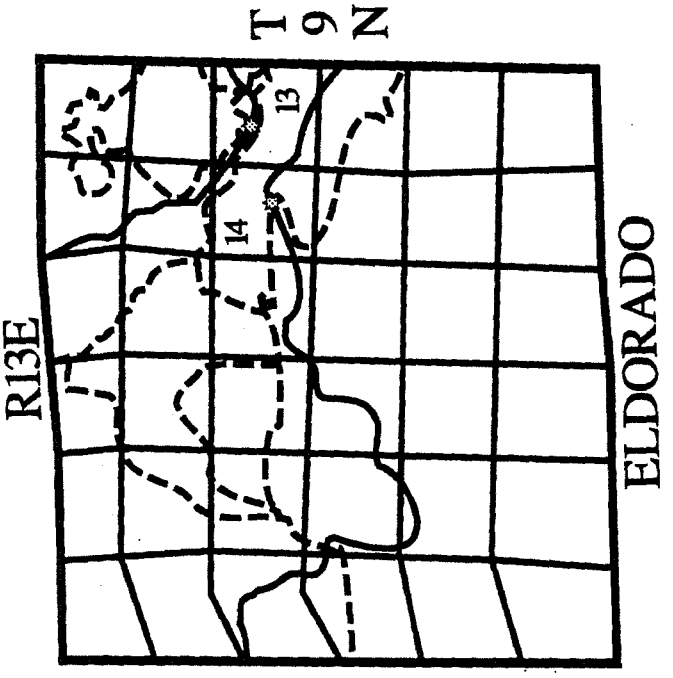
Appendix A





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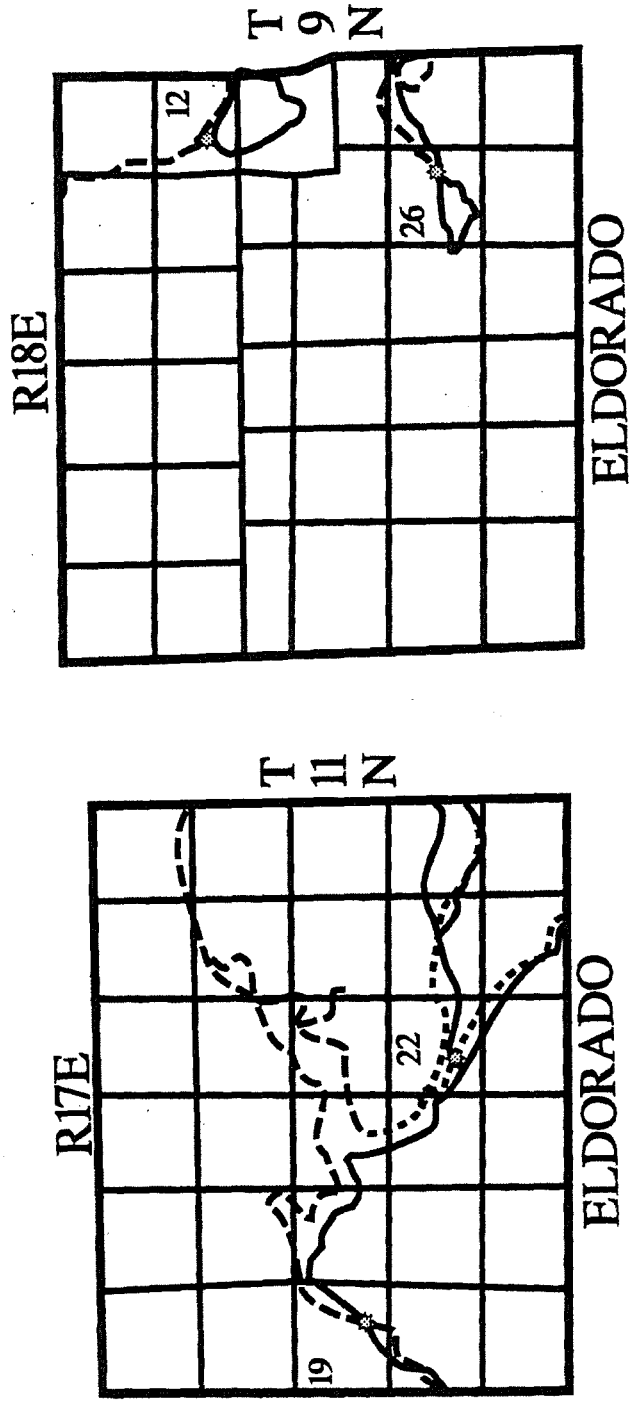

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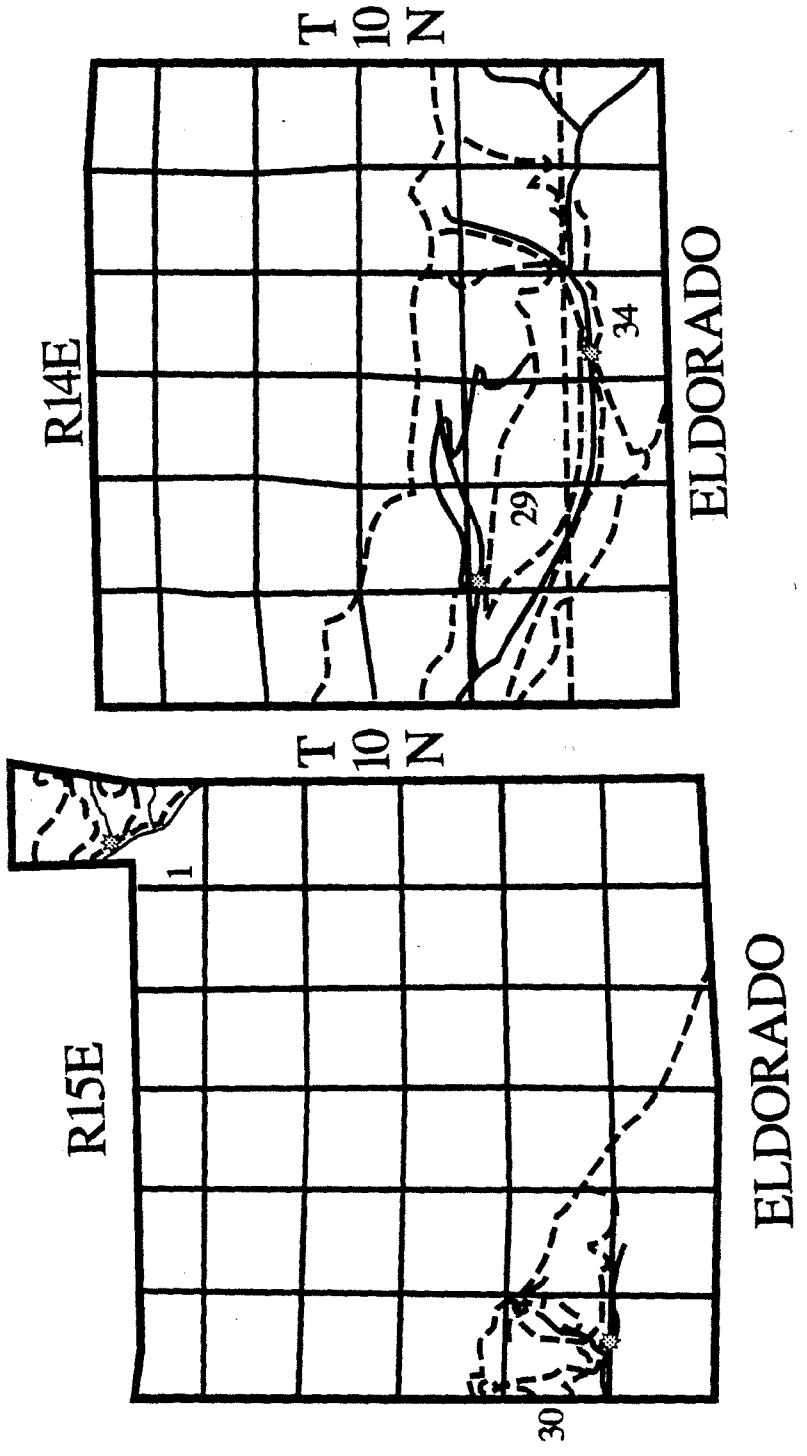

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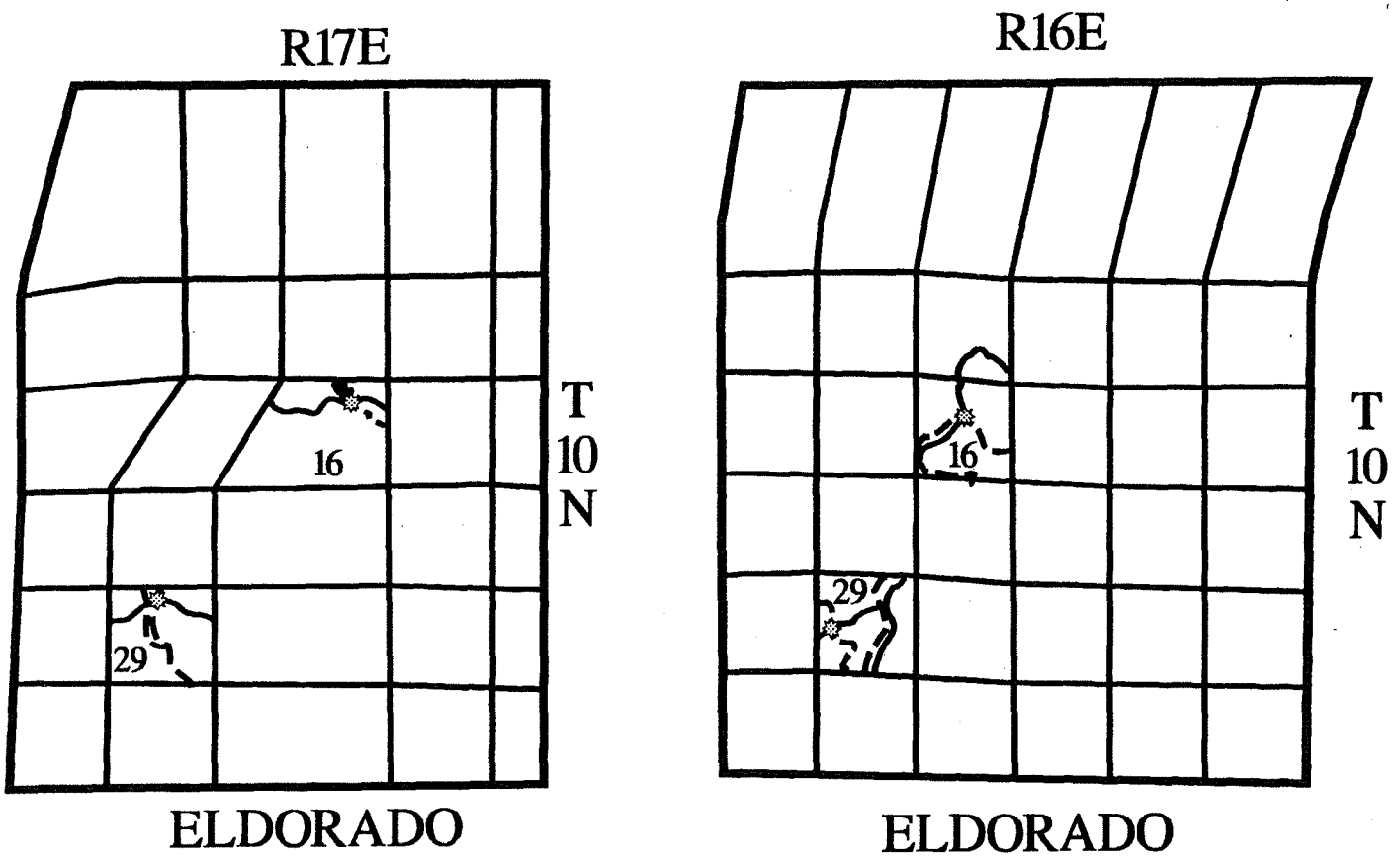

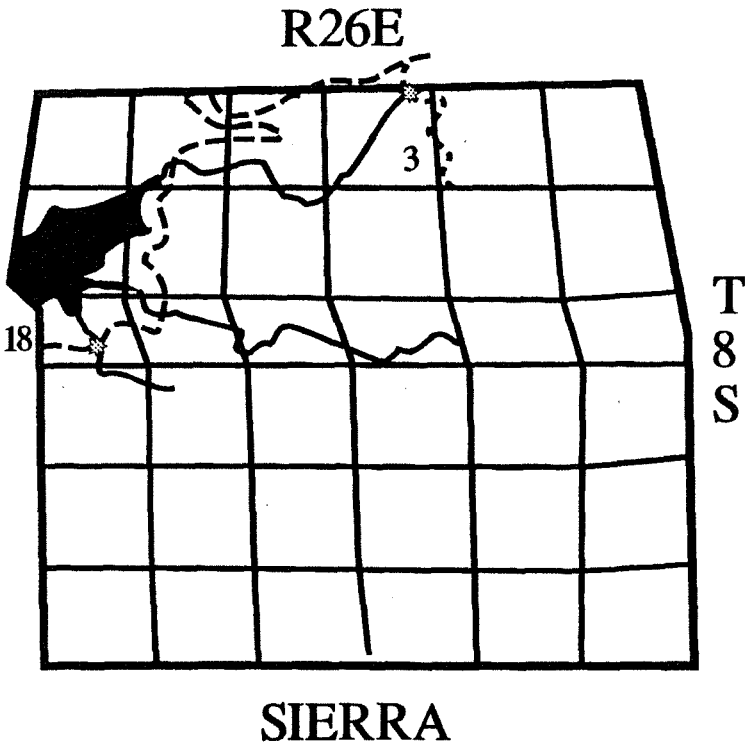
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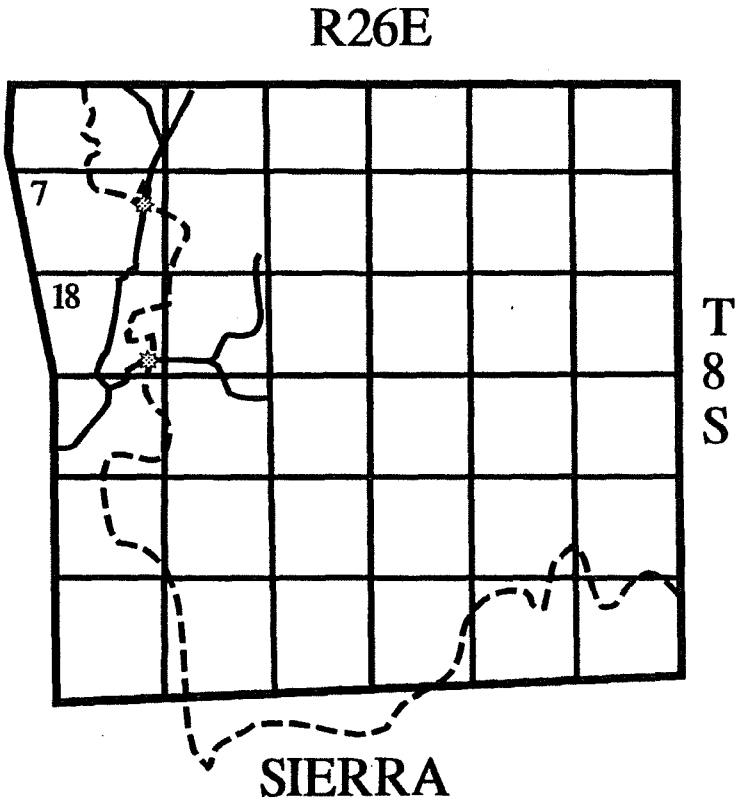
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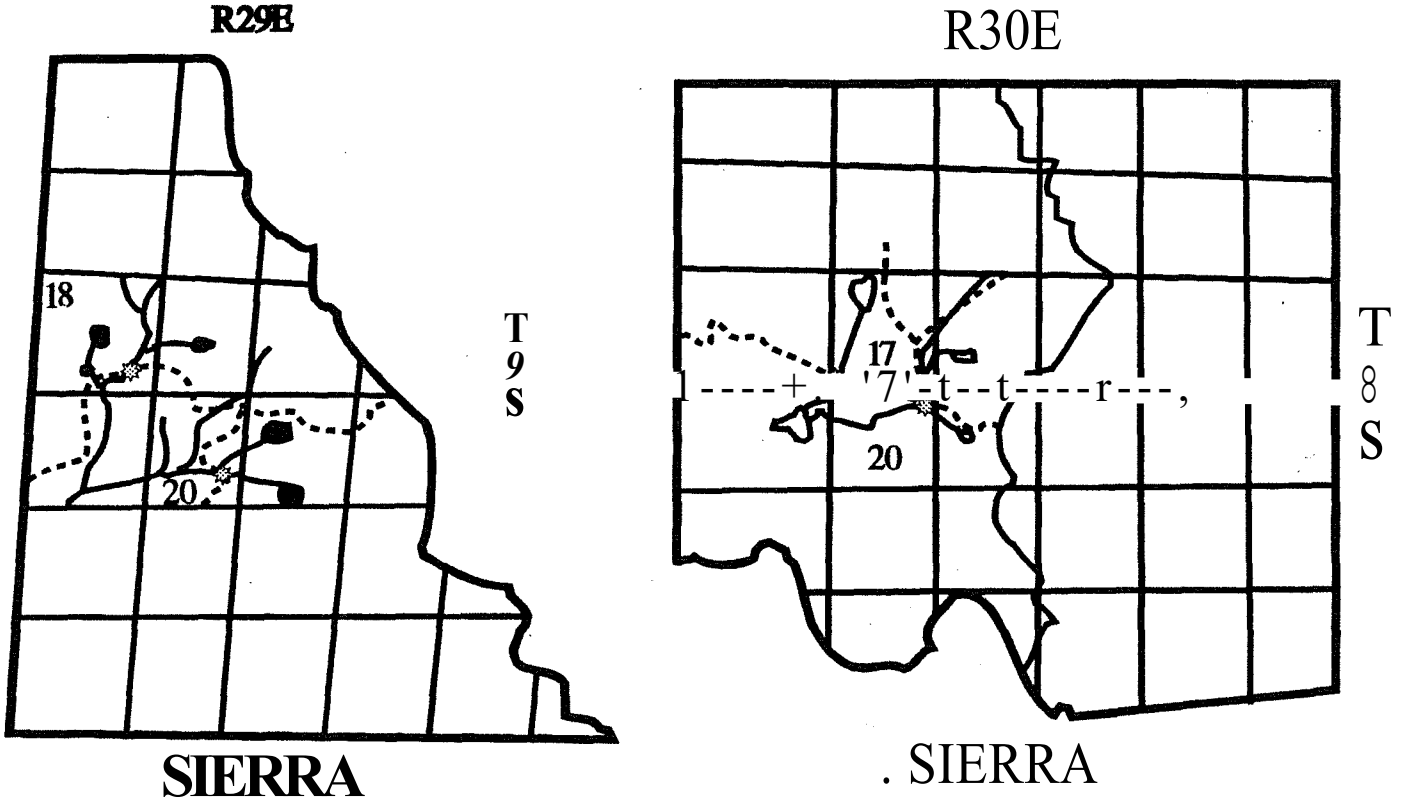

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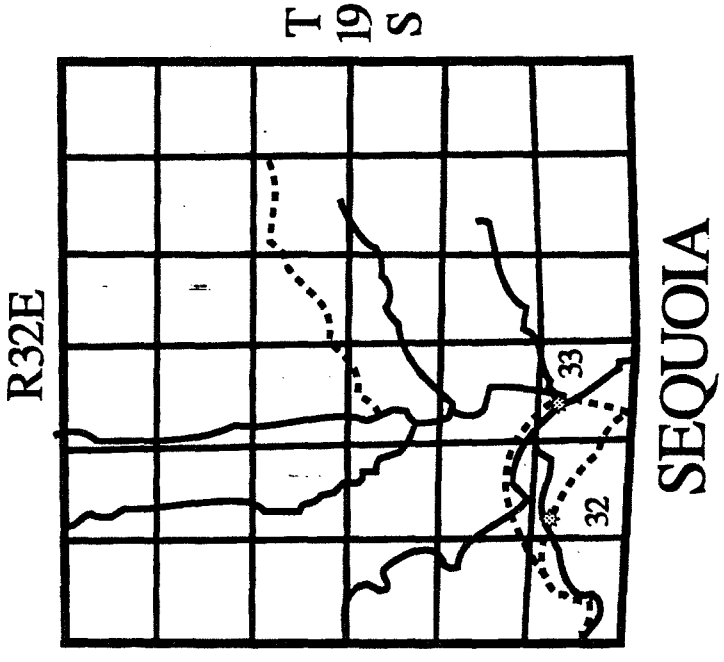

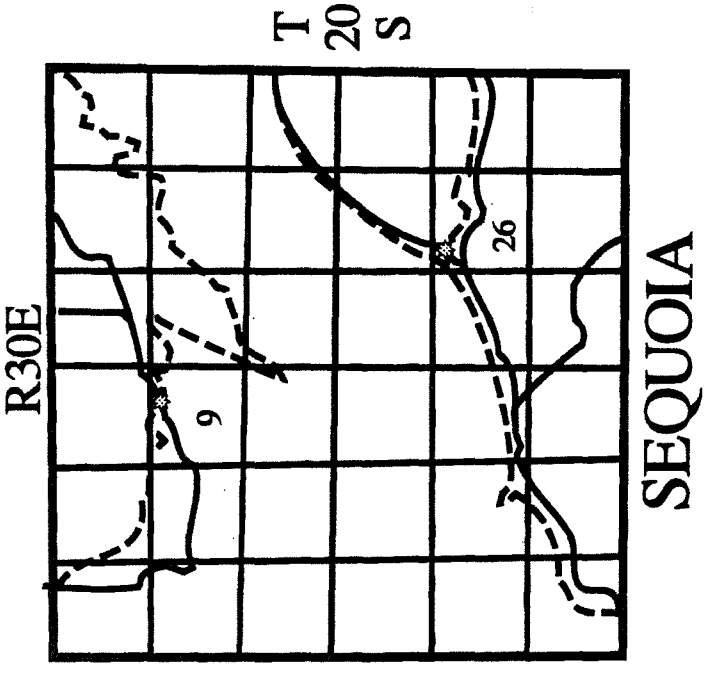

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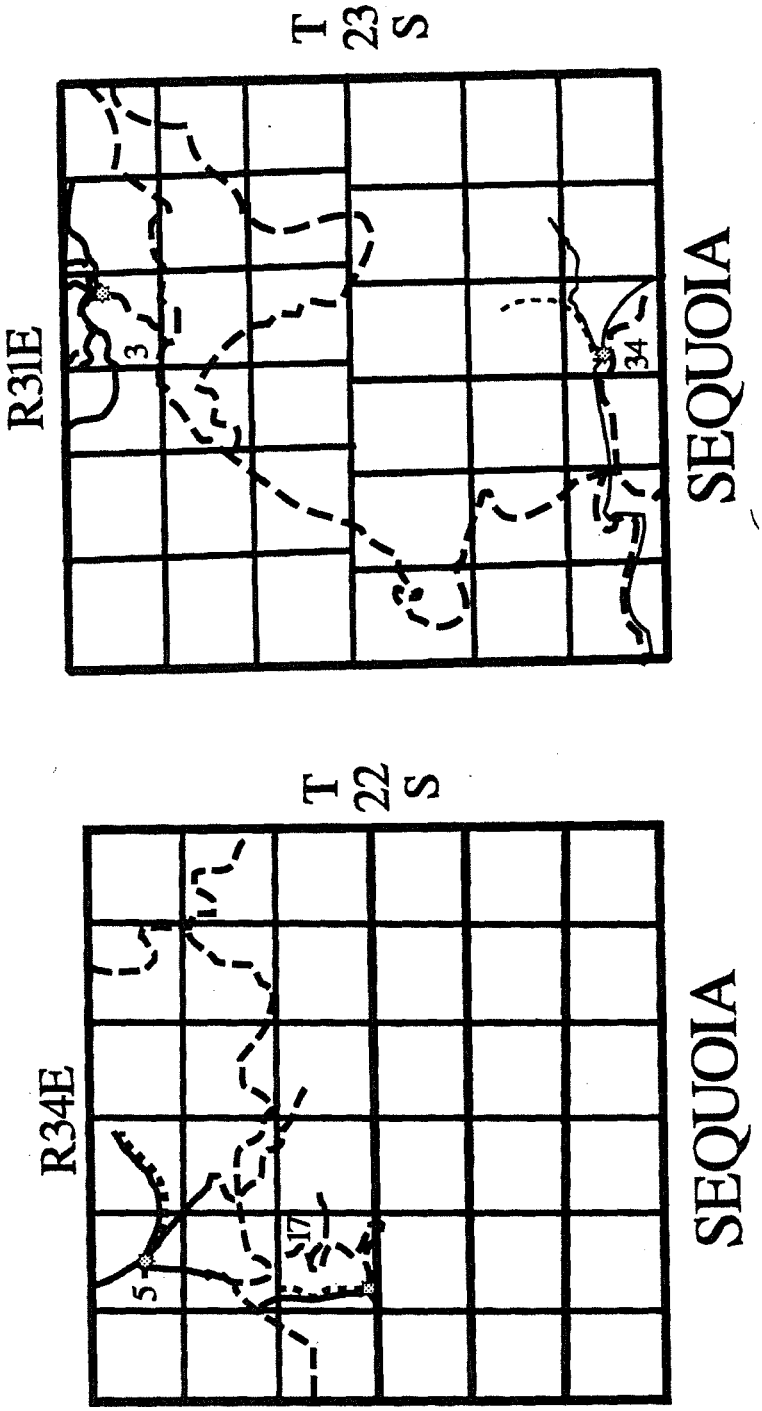

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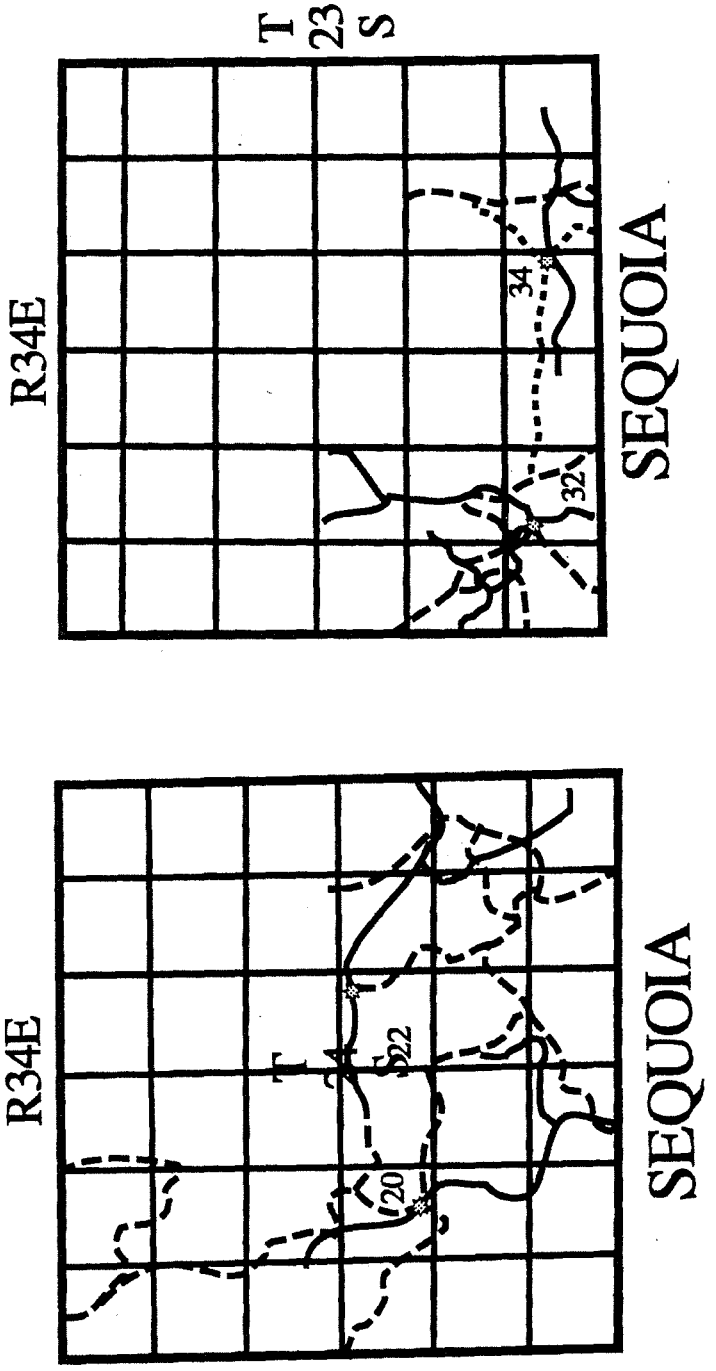

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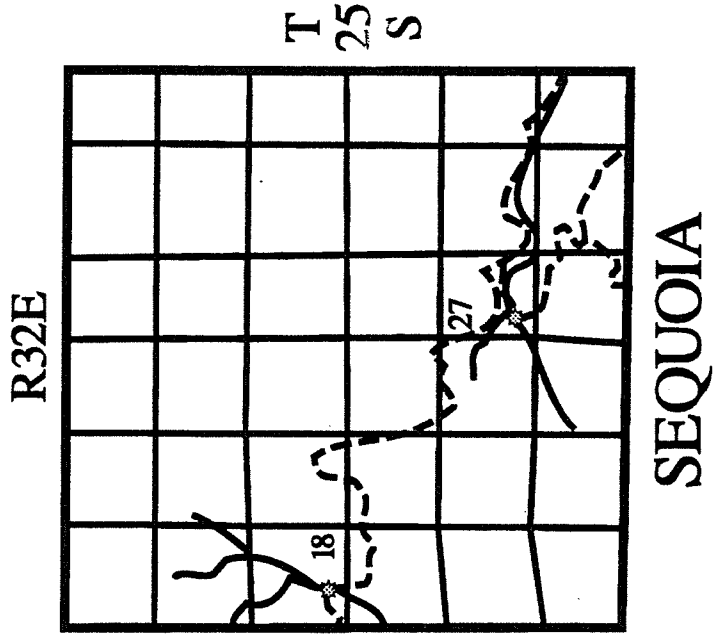

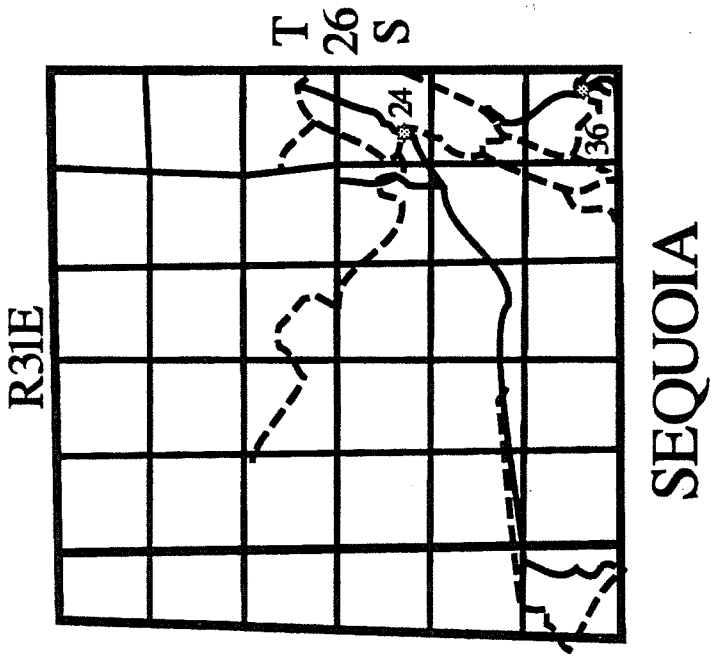

Appendix B

Eldorado National Forest, 1992 Data Summary

Forest	Township	Range	Section	Date Time Started	Elevation	Survey Stream Direction	Meters Stream Surveyed
Eldorado	T9N	R13E	14	6/2/92 9:40	Low	Up	1069.7
Eldorado	T9N	R13E	14	6/1/92 10:30	Low	Down	1021.8
Eldorado	T9N	R13E	13	6/4/92 8:49	Low	Up	765.9
Eldorado	T9N	R13E	13	6/3/92 9:52	Low	Down	279.5
Eldorado	T9N	R13E	SUM		Low		3136.9
Eldorado	T10N	R14E	29	6/11/92 10:39	Low	Up	1163.5
Eldorado	T10N	R14E	29	6/10/92 10:49	Low	Down	854.7
Eldorado	T10N	R14E	34	6/9/92 11:04	Low	Up	1669.5
Eldorado	T10N	R14E	34	6/8/92 10:14	Low	Down	1410
Eldorado	T10N	R14E	SUM		Low		5097.7
Eldorado	T10N	R15E	1	6/16/92 8:48	Low	Up	1422.3
Eldorado	T10N	R15E	1	6/15/92 9:12	Low	Down	1562.5
Eldorado	T10N	R15E	30	6/18/92 9:16	Low	Up	1162.3
Eldorado	T10N	R15E	30	6/17/92 14:05	Low	Down	1118.7
Eldorado	T10N	R15E	SUM		Low		5265.8
Eldorado	T10N	R16E	16	7/8/92 12:18	Low	Up	953.1
Eldorado	T10N	R16E	16	7/6/92 10:16	Low	Down	1092.5
Eldorado	T10N	R16E	29	7/9/92 13:49	Low	Up	1622.1
Eldorado	T10N	R16E	29	7/9/92 8:34	Low	Down	1070.9
Eldorado	T10N	R16E	SUM		Low		4738.6
Eldorado	T10N	R17E	16	6/25/92 10:14	High	Up	983.7
Eldorado	T10N	R17E	16	6/24/92 12:32	High	Down	870.8
Eldorado	T10N	R17E	29	6/23/92 10:25	High	Up	841
Eldorado	T10N	R17E	29	6/22/92 10:28	High	Down	994
Eldorado	T10N	R17E	SUM		High		3689.5
Eldorado	T11N	R17E	19	7/15/92 10:17	High	Up	1561.1
Eldorado	T11N	R17E	19	7/14/92 9:45	High	Down	1562.3
Eldorado	T11N	R17E	22	7/17/92 13:51	High	Up	807.6
Eldorado	T11N	R17E	22	7/17/92 8:42	High	Down	895.8
Eldorado	T11N	R17E	SUM		High		4826.8
Eldorado	T9N	R17E	4	7/21/92 9:25	High	Up	905.8
Eldorado	T9N	R17E	4	7/20/92 8:42	High	Down	110.3
Eldorado	T9N	R17E	16	7/24/92 9:46	High	Up	1872.2
Eldorado	T9N	R17E	16	7/22/92 9:31	High	Down	2127
Eldorado	T9N	R17E	SUM		High		5015.3
Eldorado	T9N	R18E	12	7/31/92 10:30	High	Up	1854.3
Eldorado	T9N	R18E	12	7/30/92 9:52	High	Down	57.2
Eldorado	T9N	R18E	26	7/29/92 10:24	High	Up	165.1
Eldorado	T9N	R18E	26	7/28/92 11:04	High	Down	558.9
Eldorado	T9N	R18E	SUM		High		2635.5
Eldorado Summary							**34406**

Data Collected and Compiled by Canorus Ltd.

Appendix B

Eldorado National Forest, 1992 Data Summary

Meters Tributary Surveyed	Meters Meadow Surveyed	Meters Lake Surveyed	Total Meters Surveyed	Minutes Stream Surveyed	Minutes Tributary Surveyed	Minutes Meadow Surveyed	Minutes Lake Surveyed
31.7	0	0	1101.4	290	6	0	0
0	0	0	1021.8	242	0	0	0
0	0	0	765.9	213	0	0	0
0	0	0	279.5	51	0	0	0
31.7	0	0	3168.6	796	6	0	0
0	152.6	0	1316.1	266	0	34	0
0	0	0	854.7	283	0	0	0
0	0	0	1669.5	290	0	0	0
0	0	0	1410	288	0	0	0
0	152.6	0	5250.3	1127	0	34	0
0	0	0	1422.3	305	0	0	0
0	0	0	1562.5	283	0	0	0
0	75.5	0	1237.8	248	0	39	0
0	0	0	1118.7	251	0	0	0
0	75.5	0	5341.3	1087	0	39	0
33.6	0	0	986.7	246	17	0	0
0	0	0	1092.5	287	0	0	0
0	0	0	1622.1	270	0	0	0
50.8	0	0	1121.7	261	8	0	0
84.4	0	0	4823	1064	25	0	0
0	0	0	983.7	268	0	0	0
0	0	0	870.8	281	0	0	0
0	304	0	1145	133	0	168	0
102.7	0	0	1096.7	272	24	0	0
102.7	304	0	4096.2	954	24	168	0
0	0	0	1561.1	297	0	0	0
0	0	0	1562.3	300	0	0	0
0	184.6	0	992.2	227	0	42	0
50.2	0	0	946	258	14	0	0
50.2	184.6	0	5061.6	1082	14	42	0
0	0	0	905.8	295	0	0	0
0	0	803.5	913.8	47	0	0	234
0	0	0	1872.2	284	0	0	0
0	0	0	2127	299	0	0	0
0	0	803.5	5818.8	925	0	0	234
51.2	62.3	0	1967.8	245	12	28	0
0	490.1	0	547.3	13	0	262	0
0	285.3	0	450.4	52	0	227	0
100.6	0	448.8	1108.3	141	21	0	132
151.8	837.7	448.8	4073.8	451	33	517	132
421	**1554**	**1252**	**37633.6**	**7486**	**102**	**800**	**366**

Data Collected and Compiled by Canorus Ltd.

Appendix B

Eldorado National Forest, 1992 Data Summary

Total Minutes Surveyed	Stream	Road or Trail	Non Target Herps	Introduced Non Target Species
296	S. Fk. Consumnes	Grizzly Flat Rd.	2 gopher	trout
242	S. Fk. Consumnes	Grizzly Flat Rd.		
213	Big Canyon Cr.	Lincon Hill Rd.		
51	Big Canyon Cr.	Lincon Hill Rd.		
802				
300	Snow Cr.	Big Pebble Can. Rd.	1 skink	trout
283	Snow Cr.	Big Pebble Can. Rd.	1 turtle	trout
290	Camp Cr.	North-South Rd.	1 garter	trout
288	Camp Cr.	North-South Rd.	3 garter	trout
1161				
305	Silver Fork American R.	Silver Fork Rd.		
283	Silver Fork American R.	Silver Fork Rd.		
287	Camp Cr. (not trib)	Dirt Rd.		
251	Camp Cr. (not trib)	Dirt Rd.	1 garter	
1126				
263	Bark/Shant Can. Cr	Shanty Can. Rd.		
287	Bark/Shant Can. Cr	Shanty Can. Rd.		
270	Martin Cr.	Rd. 10N28		
269	Martin Cr.	Rd. 10N28		trout
1089				
268	Caples Cr. Trib.	Lk. Margaret Tr.		
281	Caples Cr. Trib.	Lk. Margaret Tr.		
301	American River Trib.	Hwy 88		trout, cattle
296	American River Trib.	Hwy 88	1 rubber	
1146				
297	Strawberry Cr.	42 Mile Rd.		
300	Strawberry Cr.	42 Mile Rd.		
269	Sayles Can. Cr.	S. Brian Mdw. Tr.		
272	Sayles Can. Cr.	S. Brian Mdw. Tr.		trout
1138				
295	N. Silver Lk. Trib.	Kit Carson Rd.		
281	N. Silver Lk. Trib.	Kit Carson Rd.		trout
284	Hidden Lk. Str.	Hidden Lk. Tr.		
299	Hidden Lk. Str.	Hidden Lk. Tr.		
1159				
285	Upper Blue Lk. Cr.	Blue Lk. Rd.		
275	Upper Blue Lk. Cr.	Blue Lk. Rd.		trout
279	Mdw. Lk. Cr.	Mdw Lk. Rd.	500 newt, 2 garter	
294	Mdw. Lk. Cr.	Mdw Lk. Rd.		trout
1133				
8754				

Data Collected and Compiled by Canorus Ltd.

Appendix B

Eldorado National Forest, 1992 Data Summary

Pacific treefrog				Calif. red-legged frog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	20	1	21	0	0	0	0
0	0	3	3	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	20	4	24	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	1000	0	1000	0	0	0	0
0	0	0	0	0	0	0	0
0	1000	0	1000	0	0	0	0
0	**1020**	**4**	**1024**	**0**	**0**	**0**	**0**

Data Collected and Compiled by Canorus Ltd.

Appendix B

Eldorado National Forest, 1992 Data Summary

Foothill yellow-legged frog				Bullfrog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix B

Eldorado National Forest, 1992 Data Summary

Mt. yellow-legged frog				California toad			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix B

Eldorado National Forest, 1992 Data Summary

Calif. toad X Yosemite toad				Yosemite toad			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix C

Stanislaus National Forest, 1992 Data Summary

Forest	Township	Range	Section	Date Time Started	1 Low 2 High Elevation	1 UP 2 DOWN Stream	Meters Stream Surveyed
Stanislaus	T1S	R18E	28	6/2/92 9:52	Low	Up	1587.1
Stanislaus	T1S	R18E	28	6/1/92 9:40	Low	Down	1441.5
Stanislaus	T1S	R18E	29	6/4/92 10:10	Low	Up	1144
Stanislaus	T1S	R18E	29	6/3/92 9:29	Low	Down	575.3
Stanislaus	**T1S**	**R18E**	**SUM**		**Low**		**4747.9**
Stanislaus	T1S	R19E	33	6/9/92 10:12	Low	Up	1150.3
Stanislaus	T1S	R19E	33	6/8/92 10:05	Low	Down	2113
Stanislaus	T1S	R19E	31	6/11/92 9:02	Low	Up	1738.7
Stanislaus	T1S	R19E	31	6/10/92 10:05	Low	Down	1816.7
Stanislaus	**T1S**	**R19E**	**SUM**		**Low**		**6818.7**
Stanislaus	T2S	R19E	7	6/16/92 10:02	Low	Up	2147.1
Stanislaus	T2S	R19E	7	6/15/92 12:14	Low	Down	2659.8
Stanislaus	T2S	R19E	30	6/18/92 10:15	Low	Up	1442
Stanislaus	T2S	R19E	30	6/22/92 12:07	Low	Down	563.7
Stanislaus	**T2S**	**R19E**	**SUM**		**Low**		**6812.6**
Stanislaus	T7N	R16E	26	7/26/92 9:00	Low	Up	943.5
Stanislaus	T7N	R16E	26	7/25/92 12:00	Low	Down	875.9
Stanislaus	T7N	R16E	35	6/25/92 9:02	Low	Up	877.6
Stanislaus	T7N	R16E	35	6/24/92 12:12	Low	Down	726.8
Stanislaus	**T7N**	**R16E**	**SUM**		**Low**		**3423.8**
Stanislaus	T6N	R20E	5	6/30/92 12:10	High	Up	1255.5
Stanislaus	T6N	R20E	5	6/29/92 12:07	High	Down	1190.7
Stanislaus	T6N	R20E	6	7/2/92 9:00	High	Up	1416.7
Stanislaus	T6N	R20E	6	7/1/92 11:23	High	Down	1288
Stanislaus	**T6N**	**R20E**	**SUM**		**High**		**5150.9**
Stanislaus	T8N	R19E	15	7/7/92 10:11	High	Up	101.3
Stanislaus	T8N	R19E	15	7/6/92 11:41	High	Down	1639.1
Stanislaus	T8N	R19E	29	7/9/92 9:05	High	Up	1489
Stanislaus	T8N	R19E	29	7/8/92 12:50	High	Down	988.5
Stanislaus	**T8N**	**R19E**	**SUM**		**High**		**4217.9**
Stanislaus	T5N	R21E	18	7/14/92 14:15	High	Up	1130.5
Stanislaus	T5N	R21E	18	7/14/92 8:32	High	Down	994.2
Stanislaus	T5N	R21E	17	7/15/92 13:52	High	Up	1162.4
Stanislaus	T5N	R21E	17	7/15/92 8:30	High	Down	1124.3
Stanislaus	**T5N**	**R21E**	**SUM**		**High**		**4411.4**
Stanislaus	T3N	R20E	6	7/21/92 14:26	High	Up	1867.3
Stanislaus	T3N	R20E	6	7/22/92 11:18	High	Down	1559.4
Stanislaus	T3N	R20E	3	7/23/92 13:00	High	Up	111.2
Stanislaus	T3N	R20E	3	7/24/92 9:00	High	Down	95.1
Stanislaus	T3N	R20E	SUM		High		3633
Stanislaus Summary							**39216**

Data Collected and Compiled by Canorus Ltd.

Appendix C

Stanislaus National Forest, 1992 Data Summary

Meters Tributary Surveyed	Meters Meadow Surveyed	Meters Lake Surveyed	Total Meters Surveyed	Minutes Stream Surveyed	Minutes Tributary Surveyed	Minutes Meadow Surveyed	Minutes Lake Surveyed
50.6	0	0	1637.7	296	7	0	0
48.8	0	0	1490.3	305	7	0	0
0	0	0	1144	320	0	0	0
20.3	0	0	595.6	352	8	0	0
119.7	0	0	4867.6	1273	22	0	0
0	14.3	0	1164.6	216	0	8	0
0	82.9	0	2195.9	279	0	34	0
52.9	48.1	0	1839.7	270	5	26	0
0	0	0	1816.7	337	0	0	0
52.9	145.3	0	7016.9	1102	5	68	0
140.1	0	0	2287.2	315	17	0	0
99.3	0	0	2759.1	298	16	0	0
53.1	0	0	1495.1	317	16	0	0
24.6	0	0	588.3	286	16	0	0
317.1	0	0	7129.7	1216	65	0	0
0	0	0	943.5	306	0	0	0
0	0	0	875.9	300	0	0	0
0	90.2	0	967.8	246	0	92	0
0	41.4	0	768.2	251	0	67	0
0	131.6	0	3555.4	1103	0	159	0
48.5	61.8	0	1365.8	235	8	63	0
0	36.6	0	1227.3	280	0	27	0
0	0	0	1416.7	301	0	0	0
53.6	0	0	1341.6	292	10	0	0
102.1	98.4	0	5351.4	1108	18	90	0
0	720.2	0	821.5	20	0	280	0
51	0	0	1690.1	289	11	0	0
0	109.8	0	1598.8	245	0	56	0
0	590.6	0	1579.1	169	0	131	0
51	1420.6	0	5689.5	723	11	467	0
0	0	0	1130.5	233	0	0	0
0	0	0	994.2	305	0	0	0
0	0	0	1162.4	300	0	0	0
100.5	0	0	1224.8	271	25	0	0
100.5	0	0	4511.9	1109	25	0	0
50.8	0	0	1918.1	288	18	0	0
0	0	0	1559.4	303	0	0	0
0	0	228.5	339.7	51	0	0	254
0	0	573.2	668.3	44	0	0	260
50.8	0	801.7	4485.5	686	18	0	514
794	**1796**	**802**	**42607.9**	**8320**	**164**	**784**	**514**

Data Collected and Compiled by Canorus Ltd.

Appendix C

Stanislaus National Forest, 1992 Data Summary

Total Minutes Surveyed	Stream	Road or Trail	Non Target Herps
303	Mdl. Fk. Stanislaus R.	Rd. 1N07	4 garter, 2 alligator
312	Mdl. Fk. Stanislaus R.	Rd. 1N07	8 garter, 2 alligator
320	S. Fk. Toulmne R.	Hwy 120 at Rainbow	3 garters
360	S. Fk. Toulmne R.	Hwy 120 at Rainbow	1 aligator, 2 blue
1295			
224	Rush Cr.	Rd. 2S30	
313	Rush Cr.	Rd. 2S30	
301	Soldier Cr.	Rd. 2S30	
337	Soldier Cr.	Rd. 2S30	
1175			
332	Big Cr.	Rd. 1S13	
314	Big Cr.	Rd. 1S13	
333	Bull Cr.	Rd. 2S02	1 blue,2 alligator,2 newt,2 turtle
302	Bull Cr.	Rd. 2S02	43 newt,1 alligator
1281			
306	Blue Cr.	Rd. 7N05	
300	Blue Cr.	Rd. 7N05	
338	Blue Cr. Trib.	Rd. 7N09	
318	Blue Cr. Trib.	Rd. 7N09	
1262			
306	Clark Fk.	Clark Fk. Camp Gnd. Rd.	
307	Clark Fk.	Clark Fk. Camp Gnd. Rd.	
301	Cottonwood Cr.	Clark Fk. Rd.	1 alligator
302	Cottonwood Cr.	Clark Fk. Rd.	
1216			
300	Mokelumne R.	Grouse Cr. Tr.	
300	Mokelumne R.	Grouse Cr. Tr.	1 alligator
301	N. Fk. Stanislaus Trib.	Heiser Lk. Tr.	
300	N. Fk. Stanislaus Trib.	Heiser Lk. Tr.	
1201			
233	Kennedy Cr. Trib.	Kennedy Tr.	
305	Kennedy Cr. Trib.	Kennedy Tr.	
300	Kennedy Cr. Trib.	Kennedy Tr.	
296	Kennedy Cr. Trib.	Kennedy Tr.	
1134			
306	Cherry Cr.	Louse Canyon Tr.	
303	Cherry Cr.	Louse Canyon Tr.	
305	Wood Lk. Trib.	Buck Mdw. Tr.	
304	Wood Lk. Trib.	Buck Mdw. Tr.	
1218			
9782			

Data Collected and Compiled by Canorus Ltd.

Appendix C

Stanislaus National Forest, 1992 Data Summary

Introduced Non Target Species	Pacific treefrog			
	Egg	Larvae	Adult	Total
trout	0	0	0	0
trout	0	0	0	0
trout	0	0	0	0
trout	0	0	0	0
	0	0	0	0
	0	0	0	0
trout	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
trout	0	0	0	0
trout	0	0	0	0
trout, cattle	0	0	0	0
trout, cattle	0	40	0	40
	0	40	0	40
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
trout	0	0	0	0
	0	0	0	0
	0	0	0	0
trout	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
trout	0	5	1	6
	0	84	0	84
	0	89	1	90
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
trout	0	119	2	121
	0	2	0	2
	0	39	1	40
	0	16	0	16
	0	176	3	179
	0	**305**	**4**	**309**

Data Collected and Compiled by Canorus Ltd.

Appendix C

Stanislaus National Forest, 1992 Data Summary

Calif. red-legged frog				Foothill yellow-legged frog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix C

Stanislaus National Forest, 1992 Data Summary

Bullfrog				Mt. yellow-legged frog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	90	2	92	0	0	0	0
0	99	5	104	0	0	0	0
0	189	7	196	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0
0	0	29	29	0	0	0	0
0	0	30	30	0	0	0	0
0	0	0	0

Appendix C

Stanislaus National Forest, 1992 Data Summary

Calif. toad				Calif. toad X Yosemite toad			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	11	0	11	0	0	0	0
0	11	0	11	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	**11**	**0**	**11**	**0**	**0**	**0**	**0**

Data Collected and Compiled by Canorus Ltd.

Appendix C

Stanislaus National Forest, 1992 Data Summary

Yosemite toad			
Egg	Larvae	Adult	Total
0	0	0	0
0	0	0	0
0	0	0	0

Appendix D

Sierra National Forest, 1992 Data Summary

Forest	Township	Range	Section	Date Time Started	Elevation	Stream Survey Direction	Meters Stream Surveyed
Sierra	T9S	R24E	32	6/2/92 10:34	Low	Up	65.2
Sierra	T9S	R24E	32	6/1/92 11:27	Low	Down	251.8
Sierra	T9S	R24E	11	6/4/92 10:35	Low	Up	524.7
Sierra	T9S	R24E	11	6/3/92 11:32	Low	Down	596
Sierra	T9S	R24E	SUM		Low		1437.7
Sierra	T10S	R25E	2	6/10/92 10:00	Low	Up	563.3
Sierra	T10S	R25E	2	6/9/92 11:16	Low	Down	644.9
Sierra	T10S	R25E	27	6/15/92 10:00	Low	Up	1171
Sierra	T10S	R25E	27	6/11/92 10:21	Low	Down	1223.9
Sierra	T10S	R25E	SUM		Low		3603.1
Sierra	T10S	R26E	17	6/17/92 10:12	Low	Up	671.3
Sierra	T10S	R26E	17	6/16/92 11:25	Low	Down	1501.7
Sierra	T10S	R26E	12	6/19/92 9:23	Low	Up	815.2
Sierra	T10S	R26E	12	6/18/92 10:47	Low	Down	1052.7
Sierra	T10S	R26E	SUM		Low		4040.9
Sierra	T6S	R22E	2	6/23/92 10:35	Low	Up	740.2
Sierra	T6S	R22E	2	6/22/92 10:26	Low	Down	1233.4
Sierra	T6S	R22E	8	6/25/92 9:47	Low	Up	1482.5
Sierra	T6S	R22E	8	6/24/92 9:14	Low	Down	1228.7
Sierra	T6S	R22E	SUM		Low		4684.8
Sierra	T8S	R30E	20	7/25/92 9:17	High	Up	0
Sierra	T8S	R30E	20	7/24/92 10:01	High	Down	0
Sierra	T8S	R30E	17(SW)	7/26/93 14:19	High	Up	554.6
Sierra	T8S	R30E	17(SW)	7/26/92 8:32	High	Down	316
Sierra	T8S	R30E	SUM		High		870.6
Sierra	T9S	R29E	20(SE)	7/30/92 11:50	High	Up	59.5
Sierra	T9S	R29E	20(SE)	7/29/92 12:44	High	Down	278.3
Sierra	T9S	R29E	18(SE)	8/1/92 9:00	High	Up	386.1
Sierra	T9S	R29E	18(SE)	7/31/92 10:16	High	Down	644.7
Sierra	T9S	R29E	SUM		High		1368.6
Sierra	T8S	R27E	7	8/22/92 13:57	High	Up	16.2
Sierra	T8S	R27E	7	8/21/92 13:13	High	Down	313.1
Sierra	T8S	R27E			High		0
Sierra	T8S	R27E			High		0
Sierra	T8S	R27E	SUM		High		329.3
Sierra	T8S	R26E	3	7/1/92 11:35	High	Up	149.8
Sierra	T8S	R26E	3	6/30/92 11:39	High	Down	184.7
Sierra	T8S	R26E	18	7/6/92 10:20	High	Up	455.4
Sierra	T8S	R26E	18	7/2/92 11:20	High	Down	547
Sierra	T8S	R26E	SUM		High		1336.9
Sierra Summary							**17672**

Data Collected and Compiled by Canorus Ltd.

Appendix D

Sierra National Forest, 1992 Data Summary

Meters Tributary Surveyed	Meters Meadow Surveyed	Meters Lake Surveyed	Total Meters Surveyed	Minutes Stream Surveyed	Minutes Tributary Surveyed	Minutes Meadow Surveyed	Minutes Lake Surveyed
0	0	0	65.2	303	0	0	0
0	0	0	251.8	299	0	0	0
68	0	0	592.7	180	48	0	0
34.5	0	0	630.5	243	53	0	0
102.5	0	0	1540.2	1025	101	0	0
75.8	0	0	639.1	276	14	0	0
51.3	0	0	696.2	279	17	0	0
106.2	0	0	1277.2	267	27	0	0
0	0	0	1223.9	303	0	0	0
233.3	0	0	3836.4	1125	58	0	0
28	208.1	0	907.4	164	7	128	0
51.1	0	0	1552.8	289	10	0	0
205.4	67.6	0	1088.2	177	41	72	0
150.7	33	0	1236.4	267	33	5	0
435.2	308.7	0	4784.8	897	91	205	0
0	0	0	740.2	289	0	0	0
0	34.8	0	1268.2	244	0	56	0
15	0	0	1497.5	297	4	0	0
0	124.6	0	1353.3	272	0	27	0
15	159.4	0	4859.2	1102	4	83	0
0	766.2	0	766.2	0	0	300	0
0	440.3	0	440.3	0	0	307	0
52.5	426.6	0	1033.7	116	0	145	0
0	277	0	593	49	0	227	0
52.5	1910.1	0	2833.2	165	0	979	0
0	456.6	0	516.1	15	0	284	0
50.3	286.9	0	615.5	50	6	233	0
0	664.2	0	1050.3	54	0	247	0
0	520.6	0	1165.3	92	0	210	0
50.3	1928.3	0	3347.2	211	6	974	0
0	800.4	305.8	1122.4	9	0	176	62
0	545.2	0	858.3	52	0	239	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	1345.6	305.8	1980.7	61	0	415	62
0	257.6	0	407.4	114	0	202	0
0	176.1	0	360.8	26	0	276	0
0	186	0	641.4	110	0	211	0
89	16.8	1300.2	1953	99	34	11	159
89	636.5	1300.2	3362.6	349	34	700	159
978	**6289**	**1606**	**26544.3**	**4935**	**294**	**3356**	**221**

Data Collected and Compiled by Canorus Ltd.

Appendix D

Sierra National Forest, 1992 Data Summary

Total Minutes Surveyed	Stream	Road or Trail	Non Target Herps	Introduced Non Target Species
303	Jose Cr.	Jose Basin Rd.	1 turtle	
299	Jose Cr.	Jose Basin Rd.	3 newts	
228	Stevenson Cr.	Old R.R. Grade		
296	Stevenson Cr.	Old R.R. Grade	1 turtle	trout
1126				
290	Summit Cr.	Rd. 10 S 69		
296	Summit Cr.	Rd. 10 S 69		
294	Big Cr.	Rd. 10S18	1 newt	
303	Big Cr.	Rd. 10S18		
1183				
299	Forked Mdw. Cr.	Primary 40		
299	Forked Mdw. Cr.	Primary 40		
290	Bear Mdw. Cr.	Rd. 10S66		
305	Bear Mdw. Cr.	Rd. 10S66		
1193				
289	Willow Cr.	Primary 10		
300	Willow Cr.	Primary 10		
301	Calif. Cr.	Rd. 6S47Y		
299	Calif. Cr.	Rd. 6S47Y		
1189				
300	Summit Lk. Cr.	Piute Pass Tr.		
307	Summit Lk. Cr.	Piute Pass Tr.		
261	Desolation Cr.	Piute Pass Tr.		
276	Desolation Cr.	Piute Pass Tr.		
1144				
299	Fleming Cr.k	Devils Punch Tr.		
289	Fleming Cr.k	Devils Punch Tr.		
301	Fleming Cr.k	Hell For Sure Tr.		
302	Fleming Cr.k	Hell For Sure Tr.		
1191				
247	Lake Camp Cr.	Dusy Ershim Rt.	15 garters	trout
291	Lake Camp Cr.	Dusy Ershim Rt.	16 garters	trout
0				
0				
538				
316	Rancheria Cr.	Badger Flat Tr.		
302	Rancheria Cr.	Badger Flat Tr.		
321	Coon Cr.	Hwy 168		
303	Coon Cr.	Hwy 168		
1242				
8806				

Data Collected and Compiled by Canorus Ltd.

Appendix D

Sierra National Forest, 1992 Data Summary

Pacific treefrog				Calif. red-legged frog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
5	65	0	70	0	0	0	0
1	16	0	17	0	0	0	0
0	51	0	51	0	0	0	0
1	52	0	53	0	0	0	0
7	184	0	191	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	15	0	15	0	0	0	0
0	0	0	0	0	0	0	0
0	15	0	15	0	0	0	0
0	0	3	3	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	2	2	0	0	0	0
0	0	5	5	0	0	0	0
0	225	0	225	0	0	0	0
0	0	2	2	0	0	0	0
0	0	2	2	0	0	0	0
0	0	1	1	0	0	0	0
0	225	5	230	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	9	29	38	0	0	0	0
0	0	76	76	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	9	105	114	0	0	0	0
0	0	42	42	0	0	0	0
0	0	76	76	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	118	118	0	0	0	0
0	0	20	20	0	0	0	0
0	0	56	56	0	0	0	0
0	0	31	31	0	0	0	0
0	0	4	4	0	0	0	0
0	0	111	111	0	0	0	0
7	**433**	**344**	**784**	**0**	**0**	**0**	**0**

Data Collected and Compiled by Canorus Ltd.

Appendix D

Sierra National Forest, 1992 Data Summary

Foothill yellow-legged frog				Bullfrog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix D

Sierra National Forest, 1992 Data Summary

Mt. yellow-legged frog				Calif. toad			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	**0**	**2**	**2**	**0**	**0**	**0**	**0**

Data Collected and Compiled by Canorus Ltd.

Appendix D

Sierra National Forest, 1992 Data Summary

Calif. toad X Yosemite toad				Yosemite toad			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	11	11
0	0	0	0	0	2	8	10
0	0	0	0	0	0	0	0
0	0	0	0	0	0	12	12
0	0	0	0	0	2	31	33
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
0	0	0	0	0	0	3	3
0	0	0	0	0	0	9	9
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	12	12
0	0	0	0	0	0	12	12
0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	13	13
0	**0**	**0**	**0**	**0**	**2**	**57**	**59**

Data Collected and Compiled by Canorus Ltd.

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Forest	Township	Range	Section	Date Time Started	Elevation	Stream Survey Direction	Meters Stream Surveyed
Sequoia	T20S	R30E	9	4/6/92 9:00	Low	Up	843
Sequoia	T20S	R30E	9	3/6/92 9:43	Low	Down	1221
Sequoia	T20S	R30E	26	2/6/92 9:30	Low	Up	1057
Sequoia	T20S	R30E	26	1/6/92 9:45	Low	Down	1827
Sequoia	**T20S**	**R30E**	**SUM**		**Low**		**4948**
Sequoia	T23S	R31E	3	11/6/92 9:03	Low	Up	1796
Sequoia	T23S	R31E	3	10/6/92 9:35	Low	Down	1008
Sequoia	T23S	R31E	34	9/6/92 9:36	Low	Up	1234
Sequoia	T23S	R31E	34	8/6/92 13:10	Low	Down	1492
Sequoia	**T23S**	**R31E**	**SUM**		**Low**		**5530**
Sequoia	T26S	R31E	36	18/6/92 9:12	Low	Up	2271
Sequoia	T26S	R31E	36	17/6/92 10:00	Low	Down	1696
Sequoia	T26S	R31E	24	16/6/92 9:51	Low	Up	1285
Sequoia	T26S	R31E	24	15/6/92 11:36	Low	Down	2002
Sequoia	**T26S**	**R31E**	**SUM**		**Low**		**7254**
Sequoia	T19S	R32E	21	22/7/92 8:59	Low	Up	1290
Sequoia	T19S	R32E	21	22/7/92 13:51	Low	Down	1109
Sequoia	T19S	R32E	32	20/7/92 11:24	Low	Up	2620
Sequoia	T19S	R32E	32	21/7/92 9:33	Low	Down	2646
Sequoia	**T19S**	**R32E**	**SUM**		**Low**		**7665**
Sequoia	T25S	R32E	18	24/6/92 10:15	High	Up	1186
Sequoia	T25S	R32E	18	25/6/92 9:04	High	Down	2072
Sequoia	T25S	R32E	27	23/6/92 10:06	High	Up	1628
Sequoia	T25S	R32E	27	22/6/92 10:07	High	Down	1493
Sequoia	**T25S**	**R32E**	**SUM**		**High**		**6379**
Sequoia	T24S	R34E	20	2/7/92 9:00	High	Up	0
Sequoia	T24S	R34E	20	1/7/92 10:40	High	Down	1537
Sequoia	T24S	R34E	22	30/6/92 10:45	High	Up	2215
Sequoia	T24S	R34E	22	29/6/92 11:42	High	Down	1053
Sequoia	**T24S**	**R34E**	**SUM**		**High**		**4805**
Sequoia	T23S	R34E	32	9/7/92 9:00	High	Up	695
Sequoia	T23S	R34E	32	8/7/92 9:20	High	Down	1313
Sequoia	T23S	R34E	34	7/7/92 10:40	High	Up	2181
Sequoia	T23S	R34E	34	6/7/92 11:22	High	Down	0
Sequoia	**T23S**	**R34E**	**SUM**		**High**		**4189**
Sequoia	T22S	R34E	17	14/7/92 10:06	High	Up	1947
Sequoia	T22S	R34E	17	13/7/92 11:00	High	Down	2193
Sequoia	T22S	R34E	5	16/7/92 9:25	High	Up	72
Sequoia	T22S	R34E	5	15/7/92 10:06	High	Down	2463
Sequoia	T22S	R34E	SUM		High		6675
Sequoia Summary							**47445**

Data Collected and Compiled by Canorus Ltd.

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Meters Tributary Surveyed	Meters Meadow Surveyed	Meters Lake Surveyed	Total Meters Surveyed	Minutes Stream Surveyed	Minutes Tributary Surveyed	Minutes Meadow Surveyed	Minutes Lake Surveyed
0	0	0	843	300	0	0	0
0	0	0	1221	304	0	0	0
0	0	0	1057	382	0	0	0
0	0	0	1827	318	0	0	0
0	0	0	4948	1304	0	0	0
211	114	0	2121	241	30	29	0
415	30	0	1453	239	48	13	0
218	0	0	1452	280	20	0	0
60	0	0	1552	290	10	0	0
904	144	0	6578	1050	108	42	0
162	0	0	2433	253	47	0	0
239	43	0	1978	255	21	22	0
185	0	0	1470	265	30	0	0
173	0	0	2175	282	17	0	0
759	43	0	8056	1055	115	22	0
243	0	0	1533	277	24	0	0
912	33	0	2054	186	101	14	0
200	0	0	2820	289	12	0	0
700	0	0	3346	246	61	0	0
2055	33	0	9753	998	198	14	0
203	0	0	1389	271	33	0	0
0	0	0	2072	226	0	0	0
202	0	0	1830	262	38	0	0
200	0	0	1693	271	29	0	0
605	0	0	6984	1030	100	0	0
0	3795	0	3795	0	0	318	0
0	235	0	1772	219	0	81	0
446	0	241	2902	174	29	0	101
308	760	0	2121	107	45	148	0
754	4790	241	10590	500	74	547	101
0	1990	0	2685	73	0	227	0
173	5	0	1491	243	16	40	0
200	5	0	2386	250	16	34	0
0	1730	0	1730	0	0	303	0
373	3730	0	8292	566	32	604	0
372	422	0	2741	165	25	111	0
423	293	0	2909	211	35	54	0
0	3238	0	3310	9	0	272	0
200	0	0	2663	286	12	0	0
995	3953	0	11623	671	72	437	0
6445	**12693**	**241**	**66824**	**7174**	**699**	**1666**	**101**

Data Collected and Compiled by Canorus Ltd.

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Total Minutes Surveyed	Stream	Road or Trail
300	Bear Cr.	Mountain Rd. 220
304	Bear Cr.	Mountain Rd. 220
382	Tule R. S. Mdl. Fk.	Hwy 190
318	Tule R. S. Mdl. Fk.	Hwy 190
1304		
300	Parker Mdw. Cr.	Rd. SM 107
300	Parker Mdw. Cr.	Rd. SM 107
300	Deer Cr.	Rd. 31 E 54
300	Deer Cr.	Rd. 31 E 54
1200		
300	Greenhorn Cr.	Lone Star Mine Rd.
298	Greenhorn Cr.	Lone Star Mine Rd.
295	Little Poso Cr.	Rd. 26 S 05
299	Little Poso Cr.	Rd. 26 S 05
1192		
301	Little Kern R.	Rd. 32 E 11
301	Little Kern R.	Rd. 32 E 11
301	Mountaineer	Rd. 32 E 12
307	Mountaineer	Rd. 32 E 12
1210		
304	Cedar Cr.	Hwy 155
226	Cedar Cr.	Hwy 155
300	Shirley Cr.	Rd. 25 S 32
300	Shirley Cr.	Rd.25 S 32
1130		
318	Fay Cr.	Rd. 22 S 32
300	Fay Cr.	Rd. 22 S 32
304	Taylor Cr.	Rd. 22 S 32
300	Taylor Cr.	Rd. 22 S 32
1222		
300	N. Salmon Cr.	Rd. 22 S 12
299	N. Salmon Cr.	Rd. 22 S 12
300	Manter Cr.	Rd. 22 S 12
303	Manter Cr.	Rd. 22 S 12
1202		
301	Trout Cr.	Rd. 22 S 20
300	Trout Cr.	Rd. 22 S 20
281	Bonita Cr.	Rd. 22 S 41
298	Bonita Cr.	Rd. 22 S 41
1180		
9640		

Data Collected and Compiled by Canorus Ltd.

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Non Target Herps	Introduced Non Target Species	Pacific treefrog			
		Egg	Larvae	Adult	Total
6 newt,1 sal.,1 alligator,1 garter,2 rattlers		0	0	0	0
1 newt,8 blue,1 turtle,1 alligator,1 king, 1 garter		0	80	0	80
1 newt,20 blue, 6 whip, 3 garter, 1 alligator		0	25	0	25
3 turtle, 15 blue,3 whip,11 garter,		0	0	0	0
		0	105	0	105
3 blue,4 alligator		0	0	0	0
4 blue,2 skink,2 skink, 3 alligator,5 garter		0	0	0	0
25 blue, 2 garter		0	0	0	0
1 newt egg m,5 blue,6 garter		0	0	0	0
		0	0	0	0
2 slender,70 blue,2 alligator,1 garter		1	2	0	3
37 blue,4 alligator, 1 racer		0	15	0	15
17 blue, 4 alligator		0	0	0	0
1 turtle,5 blue		0	0	0	0
		1	17	0	18
78 blue,2 alligator,3 garter, 1 rattle		0	0	0	0
4 blue		0	0	0	0
34 blue,3 skink,4 alligator,3 garter		0	0	0	0
43 blue,2 garter		0	0	0	0
		0	0	0	0
4 blue,1 garter		0	0	0	0
2 blue,5 garter		0	0	0	0
5 blue,3 alligator		0	0	0	0
19 blue,1 alligator,1 garter,1 rattle		0	12	0	12
		0	12	0	12
2 alligator		0	1198	64	1262
4 blue,5 alligator, 2 garter		0	515	41	556
24 blue, 3 alligator		0	10000	1	10001
2 blue,4 alligator,1 garter		0	12	0	12
		0	11725	106	11831
1 alligator		0	0	103	103
12 blue, 4 alligator,1 garter		0	0	9	9
9 blue,10 alligator,3 garter		0	0	0	0
12 blue,2 alligator		0	10	0	10
		0	10	112	122
6 alligator		0	0	0	0
1 blue		0	0	0	0
1 blue, 1 alligator,2 garter		0	354	4	358
8 blue,1 alligator,1 garter,1 rattle		0	0	0	0
		0	354	4	358
		1	12223	222	12446

Data Collected and Compiled by Canorus Ltd.

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Calif. red-legged frog				Fthil yellow-legged frog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Bullfrog				Mt. yellow-legged frog			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Calif. toad				Calif. toad X Yosemite toad			
Egg	Larvae	Adult	Total	Egg	Larvae	Adult	Total
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	173	63	236	0	0	0	0
0	0	10	10	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	173	73	246	0	0	0	0
0	0	574	574	0	0	0	0
0	0	18	18	0	0	0	0
0	0	0	0	0	0	0	0
0	30	2	32	0	0	0	0
0	30	594	624	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	**203**	**667**	**870**	**0**	**0**	**0**	**0**

Data Collected and Compiled by Canorus Ltd.

Appendix E

Sequoia National Forest, 1992 Survey Data Summary

Yosemite toad			
Egg	Larvae	Adult	Total
0	0	0	0
0	0	0	0
0	0	0	0